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# **External Debt and Exchange Rate Overshooting: The Case of Selected East Asian Countries**

## **Abstract:**

The accumulations of foreign debts had indeed been at a rapid phase, particularly during the last few years leading to the outbreak of the 1997 financial crises in the four most severely effected economies, namely Indonesia, the Philippines, Thailand and Korea. Interestingly, during the same period, the rates of overshooting of these East Asian currencies have also been found to increase considerably. The objective of this paper is to evaluate whether the rapid accumulation of external debts, especially since 1994, has contributed to the overshooting of the East Asian countries' currencies starting late 1997.

**Key Words:** External Debt, East Asian Countries, Exchange Rate and Overshooting.

**JEL Classifications:** F31, F34, F41.

## 1. Introduction

Due to its widespread adverse implications on various parts of the economy, evaluating causes and determinants of exchange rate volatilities have accordingly remained one of the key research agenda for both academics and policy makers. A rise in exchange-rate volatilities has in general been found to have negative consequences on the trade sector (i.e. exports and imports) in the local economy (McKenzie (1999), Chou (2000), Rahmatsyah, Rajaguru and Siregar (2002), Siregar and Rajan (2004) and Clark, et.al (2004))<sup>1</sup>. Based on Japan's foreign direct investment (FDI) data at aggregated as well as disaggregated industry level, Kiyota and Urata (2004) find that large volatility in real exchange rate discourages FDI. A seminal study by Calvo and Reinhart (2002) has also shown that the monetary authority needs to intervene and manage the fluctuation of the local currency in order to achieve its desire level of inflation target.

Several attempts have been made recently to particularly examine the role of external debt/borrowing in explaining the fluctuations of the local currency. Corsetti et al. (1999) and Kawai (2002) have argued that external borrowings, particularly by private commercial banks and firms are among the key factors responsible for the severity of the East Asian financial and currency crises during the late 1990s. Providing a more in-depth look at the features of currency crises, Cavallo, et.al. (2002) develop a model that suggests the size of foreign currency denominated debt of a country contributes to the occurrences of exchange rate overshooting, sudden stop of capital flows and output drop in the domestic economy. Cavallo (2005) further argues that the exposure to foreign currency liabilities magnify the cost of exchange rate depreciation. Likewise,

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<sup>1</sup> It should be noted however, Clark, et.al (2004) have found evidences that there is no clear evidence of a negative effect of exchange rates on world trade at the aggregate level. However, once the study examines the data on the bilateral level, it finds in some cases that exchange rate volatilities adversely affect trade.

Devereux and Lane (2001) underline the need “to extend the list of variables important for understanding bilateral exchange rate volatility beyond those suggested by optimal currency area theory” (pp.27). Their study shows that for developing countries, in particular, volatility in their bilateral exchange rates is strongly and negatively affected by the stock of external debt.

Supporting the findings of those early studies, Calvo, Izquierdo and Talvi (2003) find that the high debt level was partly responsible for the high swings of the real exchange rate of the Argentine peso during the collapse of the currency board regime in that country in January 2002. Combining insights from the third-generation currency crisis models with simple trade theories, Menzies and Vines (2004) develop a model of exchange rate overshooting due to a debt service multiplier.

However, most of the previous studies are largely theoretical, and hardly any of the above studies investigate the country-by-country case of the 1997 financial crisis-affected East Asian economies. Cavallo, et.al. (2002) for instance evaluates the implication of external debt on the exchange rate overshooting on a pool of 23 countries (ranging from an African country to a number of European economies). Given the cross-country empirical approach, it is therefore impossible to draw inferences for each individual economy, and conduct comparative analyses between them.

The objective of this paper is to try to understand and confirm the possible role of external/foreign debt in explaining the fluctuations of the local currencies of selected East Asian economies, namely, Indonesia, the Philippines, Thailand and South Korea during the period of pre- and post-1997 East Asian financial and currency crisis. Looking at two key categories of the external debts of these countries gathered from the BIS debt database, namely, debt securities and total claims on commercial banks located in the domestic market, the accumulations of foreign debts since early 1990s had indeed been

at a rapid phase, particularly during the last few years leading to the outbreak of the 1997 financial crises, and continued to be high several years after 1997 (Figures 1-4).

During the same period, we also find episodes of significant nominal and real exchange rate overshooting (and undershooting) of these four East Asian currencies (the Indonesian rupiah, the Philippines peso, the Thai baht and the Korean won), particularly since the beginning of the 1997 financial crisis. We introduce a model which will explicitly define overshooting of the exchange rate when the spot (or the short-run) exchange rate of a currency depreciates (appreciates) against its trading partner's currency at a percentage rate significantly more (less) than that of the long-run "equilibrium" exchange rate. In short, an overshooting situation occurs when the spot rate of the local currency has weakened further than the long-run fundamentally determined equilibrium rate, or the spot rate has not strengthened as strongly as the long-run equilibrium rate. The opposite circumstances are true for the undershooting cases.<sup>2</sup>

Our paper hopes to extend early literatures by particularly addressing the following set of questions for the previously listed four East Asian currencies. *Have the rapid accumulation of external debts contributed to the overshooting of the East Asian countries' currencies in late 1990s and early 2000s? Have the rise in the average external debt share of GDP, especially starting 1995 and 1996, contributed to the more severe overshooting of the local currencies especially in late 1997 and early 1998 when compared to the rates reported during the pre-1997 financial crisis period? Which type of external liability, i.e. the debt security or the claims on bank, to be more responsible for the high overshooting in these economies?*

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<sup>2</sup> The definition of overshooting will be clarified further in the empirical section of the paper. A similar definition has also been used by Cavallo, et.al. (2002), where an overshooting is defined as any weakening in the local currency at the rate above and beyond the depreciation of the long-run fundamental equilibrium exchange rate.

After providing background analyses on the trends of external debts and evidences of over and undershooting of these four economies in the next section of the paper, we adopt and extend the basic overshooting model of Dornbusch (1976 and 1976b) in section 3. The reduced form of the model provides us with a testable hypothesis, suggesting the higher is the external debt the more severe is the overshooting. In section 4, data and empirical testing adopted and employed to estimate the size of the overshooting and the validity of the theoretical hypothesis found in section 3. The findings for each of the four economies will also be discussed in that section. Brief concluding remarks end the paper.

## **2. Trends and Analysis**

### **2.1 External Debts of Selected East Asian Countries**

Dictated by the availability of the data, this study considers two major components of the external debt of the four East Asian economies according to BIS database, namely the total claims on banks and the total debt securities issued abroad by the individual countries (Figures 1-4).<sup>3</sup> The total claims on banks here are total bank's liabilities to their foreign creditors. The debt securities include money market instruments, bonds, and notes issued in international markets by both public and private sector borrowers. On the following paragraphs, we will analyze the quarterly trends of these two forms of external debts, both with respect to their actual amounts and their GDP shares from early 1990s to last quarter of 2003.

From 1994 to 1996, the total quarterly GDP shares of both categories of external debts for the four East Asian economies were rather moderate, ranging between 30 to 50 percent. Within the period of less than two years, all four economies had rapidly

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<sup>3</sup> Please refer to the following website:  
<http://www1.oecd.org/scripts/cde/members/debtauthenticate.asp>

accumulated external debt, reaching as low as 80 percent of the quarterly GDP for Thailand and as high as 140 percent of the quarterly GDP for the Philippines.

The rapid increase in the claims on banks located in these four economies in mid-1990s reflected the strong and predominantly bank related capital inflows in the region. With the sudden stop of capital/investment flows and the collapse of key industries at the early stages of the 1997 financial crises, a large number of commercial banks experienced a rise in the proportion of the bad loans and eventually were no longer able to service their foreign currency denominated borrowings.

A number of contrasting trends are worth highlighting from Figures 1-4. Looking at the case of Indonesia, the country has accumulated claims on bank at a relatively more rapid rate than that of the debt securities starting mid 1994 to early 1999. From first quarter of 1994 to the third quarter of 1998, the total claims on bank have increased by more than US\$3 billion (to about US\$15 billion). The debt securities have also increased from a mere US\$2 billion in early 1994 to about US\$5.5 billion in the last quarter of 1996. The total claims on bank and the debt securities were around 20 percent and 10 percent of the quarterly GDP in early 1997, respectively. By the second semester of 1998, the total claims on bank share of the quarterly GDP were close to 90 percent, more than doubled the amount of the debt securities.

In contrast, Korea and Thailand had amassed debt securities at a substantially much higher rate relative to the reported rate for claims on bank during the same period. During the first quarter 1997, Thailand had accumulated almost an equal percentage share of the quarterly GDP of these two categories of external debt at a rate slightly above 20 percent, or around US\$ 10 billions. By late 1997, the debt securities share of the quarterly GDP was about 10 percent higher than the rate of the claims on banks, at around US\$12 billions. A similar trend can also be reported for the case of Korea. By the second quarter of 1996, the two types of external debts in Korea were about the same



size (moderately over 20 percent of the quarterly GDP or around US\$31 billion). By the last quarter of 1998, the debt securities reached around US\$50.5 billions, and its share of the GDP for that quarter was more than 15 percent higher than that of the claims on banks.

Towards the end of the 1990s to the start of the present decade, there is an observed declining trend in these two categories of external debts for Indonesia. The amount of debt securities category of external debt continued to fall from around US\$6.5 billion to around US\$1.8 billion in the fourth quarter of 2001, before increased moderately to around US\$3 billion in last quarter of 2003. As for the country's total external claims on bank, its total declined to about US\$12 billion in late 2003 or around 23 percent of the GDP for that quarter from its highest level of around US\$15 billions in 1998.

As for Korea, the total amounts of the two categories of the country external debts have more or less stabilized. In one side, the bank claims dropped moderately from US\$46 billion in the first quarter of 1998 to around US\$40 billion, or around 23 percent of last quarter GDP in 2003. In contrast, the total debt securities raised to about US\$56 billion (or around 33 percent of the quarterly GDP) by end 2003 from US\$48 billion in the first quarter of 1998.

From its peak at around US\$13.3 billions (or about 44 percent of the quarterly GDP) in the second quarter of 1999, the debt securities of Thailand have gradually declined to around US\$9 billions, roughly around 22 percent of last quarter of GDP in 2003. The claims on bank, on the other hand, continued to remain quite high. After reaching around US\$15.5 billions in last quarter of 2001, the country's total debt in this category declined gradually to reach around US\$11.2 billion (34 percent of quarterly GDP) by the second quarter of 2002. However, between mid-2002 until end of 2003, the

total claims on the Thailand banks have increased rapidly and was reported to be close to US\$18 billion, or around 45 percent of the last quarter GDP in 2003.

Among the four countries examined in this paper, the Philippines has the long standing record of issuing debt securities on the international market, particularly since late 1996. The rate of accumulation of external debt in the form of debt securities grew from around 30 percent of (or about US\$6.4 billions) of the first quarter 1997 GDP to over 100 percent, roughly around US\$24 billions, of the last quarter GDP in 2003. In contrast, the claims on bank were reported at around the same size as the debt securities in the second quarter of 1997. It rose to about 80 percent of the first quarter GDP in 1999, and was gradually declining to around 40 percent of last quarter GDP in 2003, roughly about US\$9.5 billions.

## **2.2 Overshooting and Undershooting**

As briefly mentioned before, an overshooting occurs when the short-run exchange rate depreciates (appreciates) more (less) than the long-run equilibrium exchange rate. For our analyses, we examine the overshooting incidences for both the nominal effective exchange rates (NEER) and the real effective exchange rates (REER) of the local currencies of the four East Asian economies against the countries' top five trading partners' currencies. Since neither the official long-run exchange rates nor the forward rates of these currencies are available, we have to construct our own estimates. The steps taken to generate the long run and the spot rates for the NEER and the REER will be discussed in more detail at the later part of the paper. The frequency and the severity of the overshooting and undershooting of these economies are shown in Figures (6b, 6d, 7b, 7d, 8b, 8d, 9b and 9d).

Sharp contrasting evidences are reported for the pre- and post-1997 financial crisis periods. In general, the pre-crisis was a period of stability. The NEER of the

Korean won experienced almost no overshooting and undershooting. The Thailand baht had at the most only around 5 percent of overshooting and undershooting of the NEER. The Philippines peso and the Indonesian rupiah, on the other hand, had experienced double-digit rates of overshooting and undershooting as high as 14 percent and 10 percent, respectively.

The post-1997 crisis period witnessed much more volatilities in both NEER and REER of these four major East Asian currencies. The NEER of the Indonesian rupiah and the Korean won experienced overshooting by as much as 70 percent and 80 percent, respectively. The NEER of the peso, on the other hand, reported the most modest overshooting at only around 15 percent.<sup>4</sup> The baht overshoot as much as around 38 percent at the early stage of the 1997 financial crisis. Relatively similar analyses can be drawn from the trends of the REER for the pre- and post-1997 crisis periods, except that, in general, the rates are more moderate than the rates observed for NEER.

In addition to the magnitude, the frequency of the overshooting and undershooting incidences is another critical fact worth highlighting, particularly for the period immediately after the outbreak of the 1997 financial crisis. Based on a simple step of observing the sequential periods of overshooting and undershooting at the minimum rate of 20 percent, the rupiah had undoubtedly experienced the longest sequential episodes of severe overshooting (and undershooting). Immediately after the initial meltdowns of the currencies in the third quarter of 1997, the rupiah continued to experience substantial over- and undershooting in all quarters of 1998, plus two additional quarters in mid to late 1999, with the quarterly average of over 30 percent. The Korean won and the Thai baht, on the other hand, had gone through only two quarters at the most of soaring overshooting and undershooting of more than 20

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<sup>4</sup> Cavallo, et.al. (2002) report at the beginning of the 1997 financial crisis, the real effective exchange rate of the rupiah overshoot by around 155 percent, the won by about 33 percent, the baht by about 36 percent and the peso by about 16 percent.

percent. The Philippines, on the other hand, had reported a series of overshooting period, which is followed immediately by an undershooting episode. However, the average magnitude was less than 10 percent per quarter. The relatively higher frequencies and larger magnitudes of overshooting (and undershooting) of the NEER and REER seem to suggest that the 1997 East Asian financial crisis had undoubtedly affected the Indonesian rupiah most severely.

### 3. Theoretical Framework

As mentioned in the introduction of the paper, the main objective of this paper is to empirically examine the role of the external debt flows in explaining the incidences of overshooting (and undershooting) of the four East and Southeast Asian currencies. However, before any empirical testing can be conducted, it is imperative that we establish the relationship between those two variables theoretically. To construct the theoretical framework, we adopt and modify the basic framework of the Dornbusch (1976) model. The basic structures of the model are presented in the following sub-sections.

#### 3.1. Goods Market

Price reaction function is a simple Phillips Curve (Equation 1) without inflation expectations.<sup>5</sup> Here, we assume a stationary economy with no continuing inflation. Note: all key variables in this section are in log-form, unless it is otherwise noted.

$$\dot{p} = \pi(y^d - y) \quad (1)$$

$\dot{p}$  is domestic inflation ---or change in price over time. Note that price is sticky in the short-run (hence,  $\dot{p} \approx 0$ ).  $y^d$  is the aggregate demand for the goods in the domestic

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<sup>5</sup> This is the same Philips curve equation adopted by Dornbusch (1976).

economy .  $y$  is the aggregate supply of goods locally produced (exogenously determined).  $\pi$  is a positive coefficient ( $\pi > 0$ ).

Equation (2) posits that the aggregate demand for the goods positively depends on the real exchange rate ( $e - p$ ) (assuming foreign price equals to one (i.e. its log equals to zero)), income (aggregate supply), and household and government expenditures.

$$y^d = \beta_0(e - p) + \beta_1 y + c \quad (2)$$

$p$  is the domestic price level.  $e$  is the nominal exchange rate (a rise implies a depreciation of local currency).  $c$  is the total government and consumer spendings. It captures the time preference parameter, hence reflecting the social thrift in the economy.  $\beta_0$  and  $\beta_1$  are positive coefficients. The demand for goods in the market is driven by the fluctuation of the real exchange rate (nominal exchange rate and domestic price), the supply of the goods, and the level of household and government expenditures.

### 3.2. Money Market

The demand for money in the local economy is captured by the following equation (Equation (3)).

$$m^d = p + \phi y - \lambda i \quad (3)$$

$m^d$  represents the domestic demand for money.  $i$  is the domestic interest rate.  $\phi$  denotes the income-elasticity of money demand, and  $\phi > 0$ . ( $\lambda > 0$ ) is the interest-elasticity of money demand. Higher interest rate raises the opportunity cost of holding money, and therefore reduces the demand for money. An increase in the output, on the other hand, generates a rise in the transactions demand for money. Finally, the nominal

demand for money is positively proportional to the price level. As in the case of previous equations, all of these variables are in log-form.

The money market equilibrium condition ensures that the demand for money is fully met by the supply.

$$m^s = m^d = m \quad (4)$$

Where:  $m^s$  is the log of domestic money supply, and  $m$  is the log of domestic money stock.

### 3.3. International Asset Market

One of the key equations of the Dornbusch overshooting model is the uncovered interest parity condition. At its basic form, the condition simply claims that the interest rate ( $i$ ) on domestic bond must equal the interest rate of foreign bond ( $i^*$ ), plus the expected rate of depreciation of the exchange rate ( $E(\Delta)$ ). Obstfeld and Rogoff (1998) have however shown that the risk premium can potentially be quite large. Given their empirical finding, we modify the basic Dornbusch (1976) model by employing the risk premium adjusted interest rate parity condition (Equation (5)).

$$i = i^* + E(\Delta) + RP \quad (5)$$

The expected rate of nominal depreciation ( $E(\Delta)$ ) is presented as the spread between  $\bar{e}$  (the long-run equilibrium nominal exchange rate) and  $e$  (the spot nominal exchange rate).

$$E(\Delta) = \theta(\bar{e} - e) \quad (5b)$$

Where:  $\theta$  is assumed to be a positive coefficient parameter, i.e. ( $0 < \theta$ ). If  $\bar{e}$  is larger (smaller) than  $e$ , then  $E(\Delta)$  is going to be positive (negative), implying that there will be

market expectation for the local currency to depreciate (appreciate). In the long-run,  $e$  is expected to converge to  $\bar{e}$ .

$RP$  is the risk premium variable, where it is assumed to be positively influenced by the size of the external debt ( $F^*$ ) of the country.

$$RP = \alpha_0 F^* \quad (5c)$$

Note:  $\alpha_0$  is a positive coefficient parameter (i.e.  $\alpha_0 > 0$ ). Hence, the rise in the external debt will increase the risk premium. The higher is the parameter ( $\alpha_0$ ), the larger is the risk premium generated by the external borrowing. For simplicity, we assume here that ( $F^*$ ) is determined exogenously. One may argue that, within the given theoretical frameworks, there is a role for  $F^*$  in explaining the size of  $c$  (especially on the government expenditure side of it (Eq.2)). However, with the exception of few years during the early stages of the 1997 financial crises, the annual government expenditures have largely been financed by tax revenues (with a possible exception of the Philippines). During most parts of the pre-1997 financial crisis, issuances of government bonds/debt securities were largely insignificant in most of the East and Southeast Asian countries. Furthermore, a larger share of the government debts for most of these countries is associated with domestic debts (IMF (2003)). To be noted, the overall message from the theoretical framework will not be affected if we relax the assumption of exogeneity for the ( $F^*$ ).

### **3.4. External Debt and Exchange Rate Overshooting**

One of the basic findings of the overshooting model of Dornbusch (1976) claims that under the presence of short-run price rigidity, a rise in monetary aggregates such as the money supply can easily lead to an overshooting of the nominal exchange rate in the

short-run. This study extends the original model by looking at the possibility of the overshooting of the exchange rate in the short-run when the economy experiences a rise in its external debt position.

To address this pertinent question, we will derive both the short-run and long-run equilibrium conditions of the price and nominal exchange rate. From the money market and asset market equations (3 - 5c), we can derive the following short-run nominal exchange rate equation.

$$e = \left( \frac{1}{\lambda\theta} \right) [m - p - \phi y + \lambda i^* + \lambda\theta\bar{e} + \lambda\alpha_0 F^*] \quad (6)$$

Note in Equation 6, for the sake of simplicity we assume the money market equilibrium condition (Equation 4). This assumption does not change any theoretical findings in this section.

Substituting equation 2 to equation 1, and set  $\dot{p} = 0$ , the short-run equilibrium equation for the price of the goods market (Equation (7)) can easily be derived.

$$p = e + \frac{c}{\beta_0} - \frac{(1 - \beta_1)}{\beta_0} y \quad (7)$$

Next, the long-run equilibrium for the price and nominal exchange rate will also be set. In the long-run, the spot nominal exchange rate is expected to converge to the long-run nominal equilibrium rate ( $e = \bar{e}$ ). Hence from the money market and asset market equations (3 – 5c), the long-run price level ( $\bar{p}$ ) is:

$$\bar{p} = m - \phi y + \lambda(i^* + \alpha_0 F^*) \quad (8)$$

Note from Equation (7), we can also easily derive the long-run price equation from the goods market (Equation 9) by setting up ( $y^d = y$ ) and ( $e = \bar{e}$ ).

$$\bar{p} = \bar{e} + \frac{c}{\beta_0} - \frac{(1 - \beta_1)}{\beta_0} y \quad (9)$$



In the long-run, the price levels from both the goods market and the assets market are equal. Setting the price equations (8 and 9) equal to each other, we can generate the long-run equilibrium nominal exchange rate ( $\bar{e}$ ) in the market.

$$\bar{e} = m + \lambda [i^* + \alpha_0 F^*] + \left[ \frac{1 - \beta_1}{\beta_0} - \phi \right] y - \frac{c}{\beta_0} \quad (10)$$

Now, we can examine the impact of a rise in the external/foreign debt position on the short- and long-run nominal exchange rate by going back to Equation 6 and taking the partial derivative with respect to  $F^*$ .

$$\frac{\partial e}{\partial F^*} = \frac{\partial \bar{e}}{\partial F^*} + \frac{\alpha_0}{\theta} \quad (11)$$

From equation (10), we can also generate the impact of the changes in ( $F^*$ ) on the long-run equilibrium exchange rate ( $\bar{e}$ ):

$$\frac{\partial \bar{e}}{\partial F^*} = \lambda \alpha_0 > 0. \quad (12)$$

From Equations (5c and 5b), we know that ( $0 < \theta$ ) and ( $\alpha_0 > 0$ ). Thus, we can derive two possible outcomes from Equation (11).

a). If  $\frac{\alpha_0}{\theta} > 0$ , then we have an overshooting  $\left( \frac{\partial e}{\partial F^*} > \frac{\partial \bar{e}}{\partial F^*} \right)$ .

b). However, if  $\frac{\alpha_0}{\theta} \cong 0$ , overshooting does not occur  $\left( \frac{\partial e}{\partial F^*} \cong \frac{\partial \bar{e}}{\partial F^*} \right)$ . This could

be due to a very small ( $\alpha_0$ ), i.e. close to zero, or/and due to a very large ( $\theta$ ). The former captures a situation where the external borrowing (or the particular type of external borrowing) does not lead to a rise in the risk premium. On the other hand, a large ( $\theta$ ) suggests that market players consider the spread between ( $\bar{e}$ ) and ( $e$ ), i.e. the size of

expected depreciation or appreciation of the local currency, as a significant factor in influencing the rate of return of domestic bond relative to that of the foreign bond.

We can graphically illustrate the overshooting impact of a rise in the external debt (Figure 5). By solving for the price level from the money and asset market equation (6), the MS curve can easily be derived. It has a negative slope of  $(-\lambda\theta)$ . An increase in price will result in a higher demand for money (Equation 3). Domestic interest rate will go up (given a stable money supply), and local currency is expected to appreciate (a fall in  $(e)$ ).

From the goods market equation (7), we get the positively slope of IS curve. The fall in the nominal exchange rate of the local currency ( $\Delta e > 0$ ) will cause demand for the local product to go up (Equation 2). In time, the rise in demand will lead to a rise in price ( $\Delta p > 0$ ).

Let us now assume that the local economy is at the initial equilibrium condition of point (A), where price level is at  $\bar{p}$ , and exchange rate is at  $\bar{e}$ . The rise in the external debt position will increase the risk premium (Equation 5c). Given the rigidity in price in the short-run, one percentage rise in  $(F^*)$  will depreciate the local currency at the  $\left(\frac{\alpha_0}{\theta}\right)$  percentage rate (Equation 6). The MS curve shifts to  $MS(1)$ . The economy arrives

at point (B) in the short-run, where the price is still at  $\bar{p}$ , but the exchange rate has depreciated to  $e(1)$ . In the long-run, price will adjust and absorb some of the impact of the increase in the  $(F^*)$ , as indicated in (Equation 8). At the long-run equilibrium point (C), the level of price is at  $\bar{p}(1)$  and the exchange rate appreciates from its short-run level of  $e(1)$  and settles at  $e(2)$ . In summary, the rise in  $(F^*)$  causes the exchange rate to overshoot. From Figure (5), we could also conclude that the larger is the increase in

( $F^*$ ) (shown by the size of the shift in the MS curve), the greater the magnitude of the overshooting ( $e(1) - e(2)$ ).

#### 4. Empirics

The main objective of this section is to empirically test the theoretical finding of the previous section on the four East Asian currencies, namely the rupiah, peso, baht and won for the period of the early 1990s to 2004. To do so, we need to construct the short-run and the long-run equilibrium exchange rates and employ them to estimate the size of overshooting experienced by these currencies

Following the theoretical frameworks, we can estimate Equation 6 (for the spot-rate) and Equation 10 (for the long-run equilibrium rate). However, given the availability of the external debts data (only starting 1994 for the debt securities data set for all countries), the estimations for the short-run and the long-run exchange rate, with as many as six independent variables, run into a degree of freedom problem. In addition, as nicely discussed also by Rogoff (2002), formally testing reduced form equations of the Dornbusch overshooting model or its extension is “easier said than done” (pg.12). One primary problem is with the potential endogeneity of the money supply, price, interest rate and external debt in both Equations (6 and 10).

To circumvent the estimation problem, previous studies, discussed in the introduction of the paper, have adopted the spot market nominal exchange rate or the real and nominal effective exchange rate as the short-run rate. As for the long-run equilibrium rate, the use of the forward rate has also been proposed (see Rogoff (2002)). However, the quarterly series of the forward rates since late 1980s or early 1990s are not available for these currencies. In their study, Cavallo, et.al. (2002) have instead arbitrarily defined the prevailing 24 months (or 36 months) after a crisis as the equilibrium

rate.<sup>6</sup> They conduct a regression on a pool of crisis episodes of 23 countries, including those of the Southeast Asian economies, the Latin American countries, South-Africa, Russia, and the European countries.

In the next sub-sections, we will propose theoretically based structural estimates of the short-run and long-run nominal effective (and real effective) exchange rates for these currencies. Once we generate the short and the long-run rates, the unit-root properties of the relevant series will then be evaluated before we continue to the autoregressive distributed lag regressions to test for the exchange rate overshooting implication of the external debts on the currencies of the four East Asian economies.

#### **4.1. Long-Run Equilibrium Exchange Rate**

##### **4.1.1 Nominal Effective Exchange Rate (NEER) and Purchasing Power Parity (PPP) Rate.**

The main relationship to be examined is the presence of any overshooting impact of the change in the external debt on the short-run nominal exchange rate  $\left(\frac{\partial e}{\partial F^*}\right)$  relative to that of the long-run equilibrium nominal exchange rate  $\left(\frac{\partial \bar{e}}{\partial F^*}\right)$ . Given the fact that most these countries are open economies with multiple trading partners, we will adopt the nominal effective exchange rate (NEER) index instead. The nominal effective exchange rate is constructed as the trade weighted sum of the nominal exchange rate of the local currency against the top five trading partner countries.<sup>7</sup> These top five trading

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<sup>6</sup> The study defines a crisis episode based on two categories. First, the local currency depreciated at the size of more than 10% in one month, and also has at least depreciated around 10% during the last 3 months. Second, there was an official peg or crawling peg broken. It is not clear to us as to how and why the study chooses the rate around 24 months (or 36 months) following a crisis as the equilibrium rate.

<sup>7</sup> Each country has a different list of top trading partners. But the US and Japan are listed among the top five trading partners for all of these economies.

partners make up more than 75 percent of total trade of the home country. The spot NEER is generated by the following equation.

$$NEER = \sum_{i=1} \bar{\omega}_i NEX_i \quad (13)$$

where:  $NEER$  is the domestic nominal effective exchange rate.  $\bar{\omega}_i$  is the trade weight assigned to each bilateral nominal exchange rate of domestic currency against the trading partner ( $i$ ) currency ( $NEX_i$ ). The weight is trade-weighted, calculated as the percentage share ratio of the trade of each partner country ( $i$ ) with the domestic economy. The rise in  $NEX$  and  $NEER$  implies a depreciation of the local currency.

Next, we need to generate the long-run nominal effective exchange rate. To do so, we will generate the Purchasing Power Parity rate of ( $\bar{e}$ ), captured by the following equation.

$$\bar{e} = \sum_{i=1} \bar{\omega}_i \left[ \frac{p}{p_i} \right] \quad (14)$$

where:  $p$  is the price level of home country.  $p_i$  is the price of the trading partner country ( $i$ ). The price level for the relevant countries is the consumer price index. A rise in ( $\bar{e}$ ) implies depreciation in the long-run nominal effective exchange rate of the local currency. Note the figures for the spot NEER and the PPP rate are shown in Figures (6,7, 8 and 9).

#### 4.1.2 The Real Effective Exchange Rate and The NATREX

Apart from employing the nominal effective exchange rate, a number of studies have also examined the overshooting evidence using the real effective exchange rate (REER) (refer to Rogoff (2002) and Cavallo, et.al (2002)). Given the rigidity of the price

level in the short-run, both the real and nominal exchange rate have to move in proportion in response to the initial change in the foreign/external debt. Hence, the general theoretical findings for the nominal exchange rate  $\left(\frac{\partial e}{\partial F^*} > \frac{\partial \bar{e}}{\partial F^*}\right)$  or  $\left(\frac{\partial e}{\partial F^*} \cong \frac{\partial \bar{e}}{\partial F^*}\right)$  are also applicable for the real exchange rate case (see Rogoff (2002)).

The spot REER of the local currency is the trade-weighted sum of the real exchange rate of the local currency against that of the top five trading partners' currencies (Equation 15).

$$REER = \sum_{i=1} \bar{\omega}_i REX_i \quad (15)$$

where:

$$REX_i = NEX_i * \frac{P_i}{P} \quad (15a)$$

Note:  $REX_i$  ( $NEX_i$ ) is the real (nominal) exchange rate of home currency against the currency of the trading partner country ( $i$ ). A rise in  $REX_i$  ( $NEX_i$ ) implies a depreciation of real (nominal) exchange rate of the local currency.  $\bar{\omega}$  is the trade weight as, likewise, discussed in Equations (13 and 14). As in the case of the PPP nominal effective exchange rate, we employ the consumer price index for the price variables ( $P_i$  and  $P$ ).

The long-run equilibrium ( $REER$ ), on the other hand, will be estimated by adopting the NATREX approach (Stein (1995), MacDonald and Stein (1999) and Stein and Paladino (1997 and 1999)). The basic general equilibrium framework of the NATREX theory explains the dynamic of the medium to long-run equilibrium real (effective) exchange rate. In the medium-run, external and internal equilibrium conditions

are met, while in the long-run it will also be necessary that the net foreign debt plus the capital stock reach their steady state levels.

The NATREX is an equilibrium exchange rate that ensures the balance of payment equilibrium in the absence of cyclical factors, speculative capital movements and movements in the international reserves, and the GNP is at capacity. In the long-run, those movements of capital and reserves will average out at zero, hence, the excess of national investment over national saving must be entirely financed through external / international borrowing. Hence, NATREX is an appropriate tool for estimating the long-run real exchange rate model in our study, as it highlights the important implication of the external debt on the long-run movements of the real exchange rate of a currency.

In general, there are four endogeneous equations in the basic NATREX model. The first one is the current account equation, where the size of current account is equal to national saving minus national consumption. The second equation is the uncovered interest rate parity condition. In the medium run the NATREX equilibrium real exchange rate satisfies these two equations or conditions. The transition to the longer run equilibrium is obtained by also considering the dynamics of endogenous fluctuations in capital and foreign/external debt. Hence, the accumulations of capital and external debts will directly influence investment and saving in the economy, hence the current account position.

Three exogenous variables have been listed in the basic NATREX model as the fundamental determinants of the movements / evolutions of the key variables included in the four endogeneous equations (namely investment, saving, flows of external debt and capital) . The first one is the social consumption variable, often referred to as the social thrift or the time preference variable. This variable is the sum of private and government

expenditure. Another exogeneous variable is the real productivity rate (*PROD*). The level of productivity affects the current account equation. The role of relative price or terms of trade shock (*TOT*) is also important determinant of the medium to long-run evolution of saving and investment, which then have final impacts on the current account balance and real exchange rate.

Since we are looking at the period of quarter 1, 1990 to quarter 4, 2003 (except for Korea where we have data starting at an earlier period of quarter 1, 1985), a crisis dummy (*Cdummy*) variable is also included in the model. This variable takes a value of 0 before the major devaluation of the local currency in mid to early 1997, and a value of 1 for the post devaluation period. In short, the following estimation model is considered:

$$LnREER_t = \alpha + \beta_0 LnTOT_t + \beta_1 LnRGOV_t + \beta_2 LnPROD_t + \beta_3 Cdummy + \varepsilon_t \quad (16)$$

Note: *Ln* denotes the log-normal form.

We expect the estimated coefficients for the three key explanatory variables to be negative. An improvement in the terms of trade (*TOT*) will cause a capital inflow into the tradable sector, creating a real appreciation, thus  $\beta_0 < 0$ . Note the terms of trade variable is constructed as the ratio of the unit value of export over the unit value of import of the economy.

As noted, the social consumption is the sum of private and government expenditure. However, as also shown by Stein and Paladino (1999) for their three European countries (i.e. France, Germany and Italy), we find that the fluctuations in the government expenditures have contributed more to the overall changes in the social consumption. The GDP shares of the private consumptions of these four economies are found to be stationary series at its levels, while the GDP shares of the government



expenditures are tested to be non-stationary at its levels.<sup>8</sup> Hence to capture the impact of the social consumption behavior on the real exchange rate, we only consider the real government expenditure ( $RGOV$ ). Furthermore, the changes in ( $RGOV$ ) capture the shifts in the domestic fiscal policy regime of each country. An expansionary fiscal policy appreciates the real exchange rate in the short-run. However as the current account worsens, the real exchange rate will depreciate in the long run. In short, ( $\beta_1 < 0$ ) for the short-run case and ( $\beta_1 > 0$ ) for the long run .

An increase in productivity ( $PROD$ ) is expected to improve the current account position and the improvement can be sustained even in the long run, i.e. ( $\beta_2 < 0$ ). Due to the lack of data to proxy the productivity rate, we employ GDP per capita series. The advantage of using untrended GDP per capita series, is that we are also able to capture the possible consequences of the output cycle on the movements of the real (effective) exchange rate (Mills and Pentecost, 2001; and Stockman, 1998).

To ensure that there is a potentially long-run relation (or cointegration relationship) among the variables in Equation 16. We test the commonly used ADF and the KPSS unit-root testing on all the relevant variables for each country case. The results show that all of these variables are integrated of order (1) at its levels.<sup>9</sup> Based on the cointegration results, we can confirm that there is one cointegration relationship for each of those currencies (Tables 1-5). Using the coefficient estimates for ( $\hat{\beta}_0, \hat{\beta}_1, \hat{\beta}_2$ , and  $\hat{\beta}_3$ ), we then generate the NATREX long-run equilibrium real effective exchange rate.

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<sup>8</sup> Based on the 5 percent critical value of the ADF and the KPSS unit-root testing.

<sup>9</sup> The unit-root test results for the NATREX variables are not reported in the paper, but they can be made available upon request to the authors.

$$\ln NATREX_t = \alpha + \beta_0 \ln TOT_t + \beta_1 \ln RGOV_t + \beta_2 \ln PROD_t + \beta_3 Cdummy \quad (17)$$

In general, the coefficient estimates are significant and have theoretically consistent signs, with the exception of the variable (*PROD*) for the case of rupiah and won, and for the variable (*TOT*) for the case of peso. Both the REER and the NATREX rates for the four currencies are posted in Figures (6c, 7c, 8c and 9c). These figures suggest that the four East Asian currencies were overvalued ( $NATREX > REER$ ) during the few years before the outbreak of the 1997 financial crises. The Thai baht was the most overvalued currency averaging around 11 percent per quarter between quarter 1, 1995 to quarter 1, 1997. The won, on the other hand, was only moderately overvalued at around 3 percent between quarter 1, 1996 to quarter 1, 1997. Based on the test results, the rupiah and the peso were also overvalued at a quarterly average of around 5-6 percent between quarter 1, 1995 to quarter 1, 1997.<sup>10</sup> As for the post-1997 period, the real effective exchange rates of the rupiah, peso and baht, are found to be overvalued in 2002 and 2003.

#### 4.2. Overshooting Tests: The Role of External Debts

Based on equation (11), we estimate the size of the real and nominal effective exchange rate overshooting by taking the difference between ( $\Delta e_t - \Delta \bar{e}_t$ ). where:  $\Delta e_t$  and  $\Delta \bar{e}_t$  are the quarterly percentage changes in the spot and the long-run equilibrium exchange rate of the local currency, respectively. Note a positive  $\Delta e_t$  or  $\Delta \bar{e}_t$  implies a depreciation of the spot or long-run equilibrium rate, respectively.

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<sup>10</sup> Due to the substantial depreciation of the rupiah at the third quarter of 1997, Figures 6a and 6c are not able to capture clearly the overvalued rupiah during the years of 1995 and 1996.

$\Delta e_t - \Delta \bar{e}_t > 0$  is for the case of overshooting, when the spot rate depreciation (appreciation) is more (less) than the long-run rate depreciation (appreciation). Reciprocally,  $\Delta e_t - \Delta \bar{e}_t < 0$  is for the case of undershooting. Note, we can also have the case of overshooting and undershooting when the spot rate and the long-run rate move in the opposite directions. In a nutshell, an overshooting situation occurs when the spot rate of the local currency has weakened further than the long-run fundamentally determined equilibrium rate, or the spot rate has not strengthened as strongly as the long-run equilibrium rate. The opposite circumstances are true for the undershooting cases.

As elaborated previously in section two of the paper, two categories of external debts are included in the testing: (1) total external debt claims on the commercial banks in the local economy, and (2) total external debt securities issued by local institutions. Both series were gathered from the Bank for International Settlement (BIS) database. Note here, for the testing we consider the GDP share of the external debts, not the actual amounts, as we wish to focus on the relative size of external debts with respect to the overall economy.

The Auto Regressive Distributed Lag (ARDL) testing will be adopted here. We also apply the General to Specific approach of Henry (1976) to each of the ARDL testing, where only those explanatory variables with significant coefficient estimates will be included in the final regressions. To address the possible structural break due to the 1997 financial crises in East Asia, we introduce the crisis dummy (*Cdummy*) to the ARDL regression. The dummy equals to zero for the period before the outbreak of the financial crisis in 1997 and equals to one otherwise. The following ARDL overshooting regression is tested for both exchange rates (NEER and REER) and the two categories of external debts.

$$\Delta e_t - \Delta \bar{e}_t = b_0 + b_1 (\Delta e_t - \Delta \bar{e}_t)_{t-1} + \sum_{i=0}^2 \psi_i \Delta DebtSec_{t-i} + \sum_{i=0}^2 \rho_i \Delta TotBnkClm_{t-i} + \mu Cdummy_t + \varepsilon_t$$

(18)

where:  $(\Delta DebtSec)$  and  $(\Delta TotBnkClm)$  are the percentage changes in the total GDP share of external debt securities and the total GDP share of total external debt claims on the commercial banks.  $\psi$  and  $\rho$  are coefficient estimate parameters and they are both theoretically expected to be positive, that is, a rise in the external debt will lead to an exchange rate overshooting.  $\mu$  is expected to be positive, as the incidence of overshooting should be more rampant during the crisis period.  $\varepsilon_t$  is the error term. Note, we add  $(\Delta e_t - \Delta \bar{e}_t)_{t-1}$  to capture the adjustment factor where the rate of overshooting (or undershooting) at  $(t-1)$  may contribute to the incidence of overshooting (or undershooting) at period  $(t)$ . The coefficient parameter  $(b_1)$  can either be positive or negative.

The observation period for each country is dictated by the availability of the external debt data. At the most we have data from quarter 1, 1990 to quarter 4, 2003. To ensure an adequate degree of freedom, two quarters lag are considered for the ARDL test.<sup>11</sup> Before we proceed to the actual ARDL testing, the unit-root properties of the relevant variables are to be examined first.

#### 4.2.1 Unit Root Testing

It is well known that the data generating process for most macroeconomic time series are characterised by unit roots, which puts the use of standard econometric

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<sup>11</sup> As also shown in Tables (2-5), in general we do not find the estimate coefficients of the explanatory variables at any higher lags (beyond two quarters) to be significant.

methods under question. Therefore, it is important to analyse the time series properties of the data in order to avoid spurious results. To ensure the robustness of the test results, two most commonly used unit-root tests are applied here, namely the Augmented Dickey-Fuller (ADF) and the KPSS unit root tests on the relevant variables  $((\Delta e_t - \Delta \bar{e}_t), (\Delta DebSec)$  and  $(\Delta TotBnkClm))$ . As opposed to the ADF tests for which the test statistic is constructed under the null hypothesis that the series is non-stationary, Kwiatkowski, et al., 1992 (KPSS) propose their test procedure in which the null hypothesis is stationary.

Both the ADF and the KPSS unit-root testing confirm that all of the relevant variables (the nominal and real effective exchange rate overshooting rates  $(\Delta e_t - \Delta \bar{e}_t)$ , and the changes in the external debts  $((\Delta DebSec)$  and  $(\Delta TotBnkClm))$  are stationary series  $---I(0)$ . For the sake of brevity, the test results are not reported in the paper.<sup>12</sup>

#### **4.2.2 Analyses on Test Results**

The ARDL test results are posted in Tables (2-5). Two main findings are worth highlighting. First, the coefficient estimates for the parameters  $(\psi$  and  $\rho)$  are both reported to be positive and significant for all the testing conducted, except for the REER of the peso. Thus, this implies that the higher is the accumulation of the rate of external debts, the more severe is the overshooting of the NEER and the REER of the local currencies in these four countries. In short, the empirical results present conclusive evidences that the rapid accumulations in one or both groups of external debts prior to the outbreak of the 1997 financial crisis in these four economies have significantly

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<sup>12</sup> However they can be made available upon request to the authors.

contributed to the incidences of overshooting using both the NEER and the REER of the four local currencies.

Second, the test results also suggest that the overshooting of the Indonesian rupiah has been driven largely by the accumulations of the claims on banks. In contrast, the role of debt securities is more significant for the cases of peso, baht and won. These findings are arguably consistent with the stylized facts presented in Section 2.1 of the paper. The growth rates on the claims on bank for Indonesia were significantly higher than the rates for debt securities. The opposite trends occurred for the cases of the Philippines, Korea and Thailand, where the buildup rates of the debt securities were significantly higher than the rates for the claims on banks.

Third, the test statistics also suggest that the flows of external debts have immediate implications on the fluctuations of these currencies, usually within the first lag period (three months). In addition, the impacts last for around two lags (six months period).

Few more detail analyses should also be discussed here. The two main findings are in general very robust. The test results for the NEER and REER are, in general, consistent with each other. The diagnostic statistics, including the  $R^2$  statistics adjusted for degrees of freedom, the Durbin-Watson (DW), the F-statistics (and its probability), and the Engle's ARCH test for heteroscedasticity, are presented for each regression. The F-statistics indicate that the probability is at least 95 percent that one or more of the independent variables are non-zero. The Durbin-Watson statistics indicate that the serial correlations are not a problem in any of the regression results. In addition, the ARCH results conclude the absence of heteroscedasticity in general, with a possible exception in the case of the NEER of the baht. Finally, the R-squares range from around 60 percent for Indonesia to about 30 percent for the case of peso.

## **5. Brief Concluding Remarks**

As a number of these East Asian economies shift to adopt inflation targeting as the main anchor of their monetary policy, the ability to manage the volatilities of the exchange rate will largely influence the capacity of the monetary authority in achieving its inflation target. Understanding factors influencing the fluctuations of the local currency is therefore imperative, especially given the more volatile foreign exchange markets in the region after the outbreak of the 1997 financial crisis.

This study starts with a theoretical framework which explicitly captures the hypothesis that external debt accumulations may lead to overshooting. Given the lack of official size of exchange rate overshooting of these currencies, we structurally estimate the short-run and the long-run equilibrium exchange rates to report the significant presence of exchange rate overshooting (and undershooting) of the four key East Asian currencies since the early 1990s. The results have shown that the currency has unquestionably become more volatile, as demonstrated by the high frequency and persistence in the overshooting (and undershooting) of the East Asia regional currencies. Based on the frequencies of the overshooting (and undershooting) of the NEER and REER, the rupiah and peso were more severely affected than the baht and the won.

To provide more insights to the overshooting phenomena, our study examines the potential role of external debt in explaining the incidences of exchange rate overshooting of those four East Asian currencies. The empirical results have shown that the accumulation of external debts in these economies have indeed been partly responsible for the increasing incidence and severity of exchange rate overshooting of the local currency. What is even more important is that the empirics have also suggested that the role of external debts associated with the banking sector has been largely responsible for the exchange rate overshooting of the rupiah, arguably, the most

severely crisis-affected East Asian currency. In contrast, the role of debt securities has been found to be more significant in explaining the exchange rate overshooting of the peso, the won and the baht.

Despite the two contrasting results, we can confidently conclude that managing and gradually reducing the high GDP share of the external debt should be placed among the foremost strategic objectives of the macroeconomic policy agenda of these countries. One obvious question is at what level can the external debt over GDP level can be considered safe? Reinhart, Rogoff and Savastano (2003) propose that a country's level of debt intolerance can be approximated empirically as the ratio of the average of its external debt (scaled by GNP or exports) to an index of default risk (determined by its repayment history and history of macroeconomics stability (such as inflation)). Their study finds for instance that the annual external debt over GNP of Malaysia can increase to as high as 30 percent, but the country remains in what the study considers to be a safe level. In contrast, Argentina will stay under the safe external debt level only if it can maintain its external debt below 15 percent of its GNP.

Any process of debt reduction, however, should be observed in a gradual phase, and in a manner that is consistent with the overall macroeconomics conditions of each economy. Large payments/service of the external borrowings within a short period of time will likely imply an unwanted massive cut in vital sources of funds for financing domestic economic activities. In turn, this will likely to drive up interest rate and hamper the overall growth of the economy.

As for the global context, our findings support for the recent commitments by the members of G-7 countries and the multilateral agencies such as the International Monetary Fund, the World Bank and the African Development Bank, to cancel around



US\$55 billion of debt of the world's most heavily indebted poor countries.<sup>13</sup> Studies by Pattillo, Poirson, and Ricci (2002) and Clements, Bhattacharya, and Nguyen (2003) suggest that an external debt beyond 30-40 percent of GDP will lower the growth rates of the domestic economy. A similar message is found in our study. The rapid accumulation of external debts will increase the risk premium and contribute to the rise in the domestic interest rate, and an overshooting in the domestic currency exchange rate. Eventually the high interest rate and volatility of the domestic currency will debilitate the growth of the local economic. Much-needed debt relief should therefore assist the governments of these economies in managing adverse implications of the external debts.

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<sup>13</sup> Press Conference on the 2005 Annual Meeting of the International Monetary and Financial Committee with Gordon Brown, UK Chancellor of the Exchequer and Chairman of the IMFC, and Rodrigo de Rato, Managing Director of the International Monetary Fund , in September 24, 2005 Washington, DC. (<http://www.imf.org/external/np/tr/2005/tr050924b.htm>).

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**Table 1: The Johansen Cointegration Test Results**

**Indonesia: REER-CPI**

Eigenvalue	Likelihood Ratio	5% Critical Value
0.4794	77.02*	68.52
0.3414	43.72	47.21
0.2119	22.43	29.68
0.1347	10.27	15.41
0.0552	2.89	3.76

\* There is 1 cointegrating equation at 5% Critical Value.

$$LnREER_t = -4.048 + 0.056LnPROD_t - 1.814LnTOT_t - 0.328LnRGOVT_t - 0.365Dummy$$

Std error:           (0.1539)\*\*           (0.3605)\*\*           (0.1148)\*\*           (0.2018)\*

\*\* Significant at 5% and \* Significant at 10%.  
Sample Observations= 1990:1-2003:4; and Number of Lags = 4

**The Philippines: REER-CPI**

Eigenvalue	Likelihood Ratio	5% Critical Value
0.5598	78.88*	68.52
0.2624	37.86	47.21
0.2072	22.64	29.68
0.1639	11.04	15.41
0.0407	2.08	3.76

\* There is 1 cointegrating equation at 5% Critical Value.

$$LnREER_t = 8.141 - 0.257LnPROD_t + 1.348LnTOT_t - 0.586LnRGOVT_t + 0.498Dummy$$

Std error:           (0.0714)\*\*           (0.3351)\*\*           (0.1108)\*\*           (0.0367)\*\*

\*\* Significant at 5% and \* Significant at 10%.  
Sample Observations= 1990:1-2003:4; and Number of Lags = 1

**Table 1: The Johansen Cointegration Test Results (cont'd)**

**Thailand: REER-CPI**

Eigenvalue	Likelihood Ratio	5% Critical Value
0.5177	78.51*	68.52
0.4109	39.14	47.21
0.1095	10.55	29.68
0.0743	4.29	15.41
0.0022	0.12	3.76

\* There is 1 cointegrating equation at 5% Critical Value.

$$LnREER_t = 4.014 - 0.647LnPROD_t - 0.875LnTOT_t + 1.733LnRGOVT_t + 0.174Dummy$$

Std error                    (0.2073)\*\*                    (0.3878)\*\*                    (0.5786)\*\*                    (0.0885)\*\*

\*\* Significant at 5% and \* Significant at 10%.  
Sample Observations= 1990:1-2003:4; and Number of Lags = 1

**Korea: REER-CPI**

Eigenvalue	Likelihood Ratio	5% Critical Value
0.4897	87.49*	68.52
0.2067	39.72	47.21
0.1555	23.28	29.68
0.0864	11.29	15.41
0.0662	4.87	3.76

\* There is 1 cointegrating equation at 5% Critical Value.

$$LnREER_t = -5.423 + 0.205LnPROD_t - 1.034LnTOT_t - 0.835LnRGOVT_t - 0.083Dummy$$

Std error:                    (0.0196)\*\*                    (0.1411)\*\*                    (0.1149)\*\*                    (0.0386)\*\*

\*\* Significant at 5% and \* Significant at 10%.  
Sample Observations= 1985:1-2004:2; and Number of Lags = 6

**Table 2: Test Results for *NEER* and *REER* of Rupiah**

**Nominal Effective Exchange Rate (NEER)**

$$\Delta NEER_t - \Delta PPP_t = 0.187 \cdot DebSec_t + 0.622 \cdot TotBnkCIm_t$$

(0.101)\*                      (0.105)\*\*

R<sup>2</sup> = 0.67. DW = 2.16. Prob(F-stat) = 0.000. ARCH(Prob) = 0.41

**Real Effective Exchange Rate (REER)**

$$\Delta REER_t - \Delta NATREX_t = 0.510(\Delta REER_t - \Delta NATREX_t)_{t-1} + 0.621 \cdot TotBnkCIm_t +$$

(0.127)\*\*    (0.094)\*\*

$$- 0.554 \cdot TotBnkCIm_{t-1}$$

(0.126)\*\*

R<sup>2</sup> = 0.65. DW = 2.16. Prob (F-stat) = 0.000. ARCH(Prob) = 0.25

\* Significant at 10 percent. \*\* Significant at 5 percent. DW: Durbin-Watson.

**Table 3: Test Results for *NEER* and *REER* of Peso**

**Nominal Effective Exchange Rate (NEER)**

$$\Delta NEER_t - \Delta PPP_t = 0.036 Cdummy_t + 0.144 \cdot DebtSec_{t-1} +$$

(0.018)\*\*                      (0.067)\*\*

$$0.125 \cdot DebtSec_{t-2} + 0.191 \cdot TotBnkCIm_t - 0.034$$

(0.059)\*                      (0.067)\*\*

R<sup>2</sup> = 0.33. DW = 2.185. Prob(F-Stat)= 0.008. ARCH(Prob) = 0.62

**Real Effective Exchange Rate (REER)**

$$\Delta REER_t - \Delta NATREX_t = 0.576(\Delta REER_t - \Delta NATREX_t)_{t-1}$$

(0.119)\*

R<sup>2</sup> = 0.332. DW = 1.789. ARCH(Prob) = 0.65

\* Significant at 10 percent. \*\* Significant at 5 percent. DW: Durbin-Watson.

**Table 4: Test Results for NEER and REER of Baht**

<b><u>Nominal Effective Exchange Rate (NEER)</u></b>	
$\Delta NEER_t - \Delta PPP_t$	$= -0.054 + 0.411 \cdot DebtSec_t + 0.191 \cdot TotBnkCIm_t +$ (0.017)** (0.092)** (0.073)*
$0.050CrisisDummy_t$	 (0.020)**
$R^2 = 0.578.$ $DW = 1.950.$ $Prob(F-Stat) = 0.0000.$ $ARCH(Prob) = 0.08$	
<b><u>Real Effective Exchange Rate (REER)</u></b>	
$\Delta REER_t - \Delta NATREX_t$	$= -0.053 + 0.445 \cdot DebtSec_t + 0.131 \cdot DebtSec_{t-1} +$ (0.018)** (0.100)** (0.080)*
$0.179 \cdot TotBnkCIm_t + 0.050Cdummy_t$	 (0.077)** (0.022)**
$R^2 = 0.59.$ $DW = 2.14.$ $Prob(F-stat) = 0.000.$ $ARCH(Prob) = 0.14$	

\* Significant at 10 percent. \*\* Significant at 5 percent. DW: Durbin-Watson.

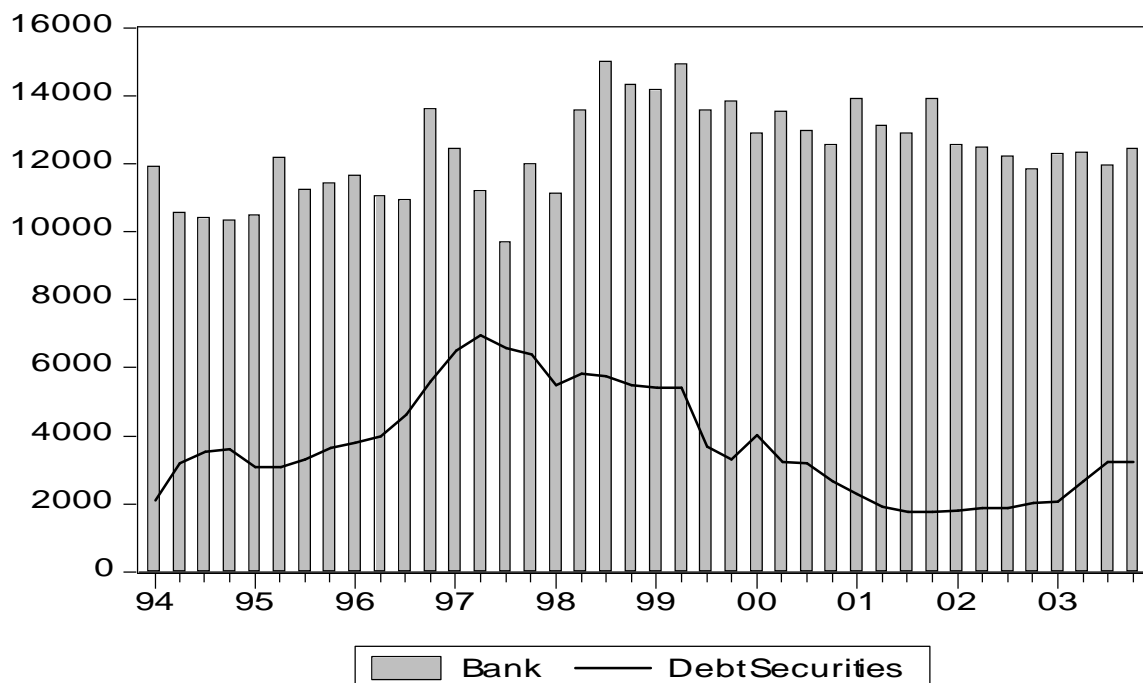
**Table 5: Test Results for NEER and REER of Won**

<b><u>Nominal Effective Exchange Rate (NEER)</u></b>	
$\Delta NEER_t - \Delta PPP_t$	$= 0.503 \cdot DebtSec_t$ (0.094)**
$R^2 = 0.40.$ $DW = 2.47.$ $ARCH(Prob) = 0.28$	
<b><u>Real Effective Exchange Rate (REER)</u></b>	
$\Delta REER_t - \Delta NATREX_t$	$= -0.064 + 0.239 \cdot DebtSec_{t-1} + 0.339 \cdot DebtSec_{t-2}$ (0.028)** (0.114)** (0.115)**
$+ 0.072CrisisDummy_t$	 (0.034)**
$R^2 = 0.24.$ $DW = 2.31.$ $Prob(F-stat) = 0.000.$ $ARCH(Prob) = 0.94$	

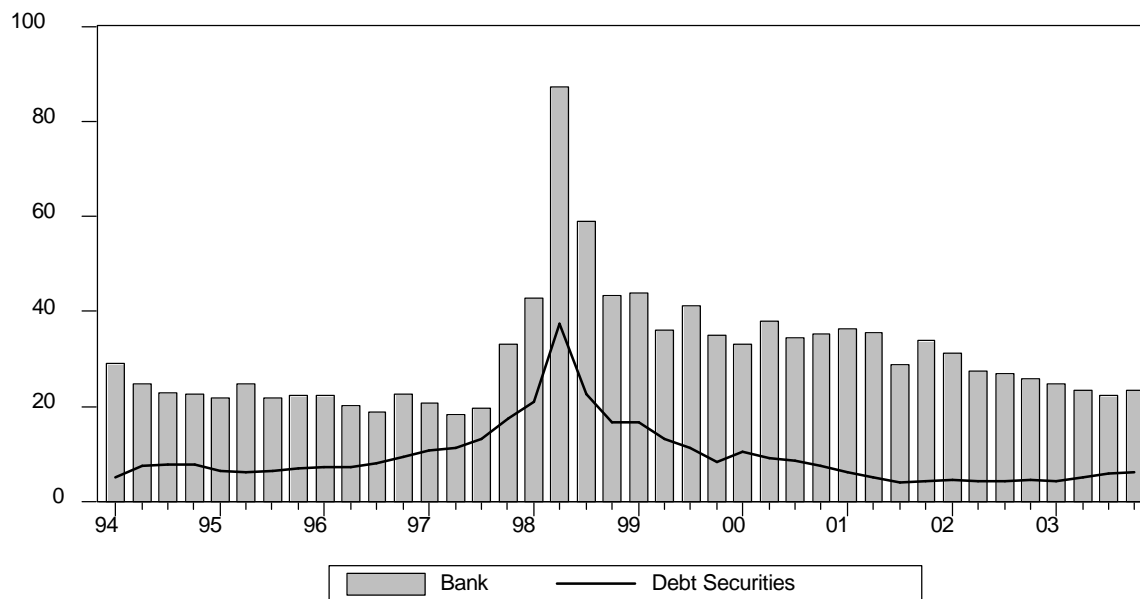
\* Significant at 10 percent. \*\* Significant at 5 percent. DW: Durbin-Watson.



**Figure 1: External Debts of Indonesia (in million of US\$)**

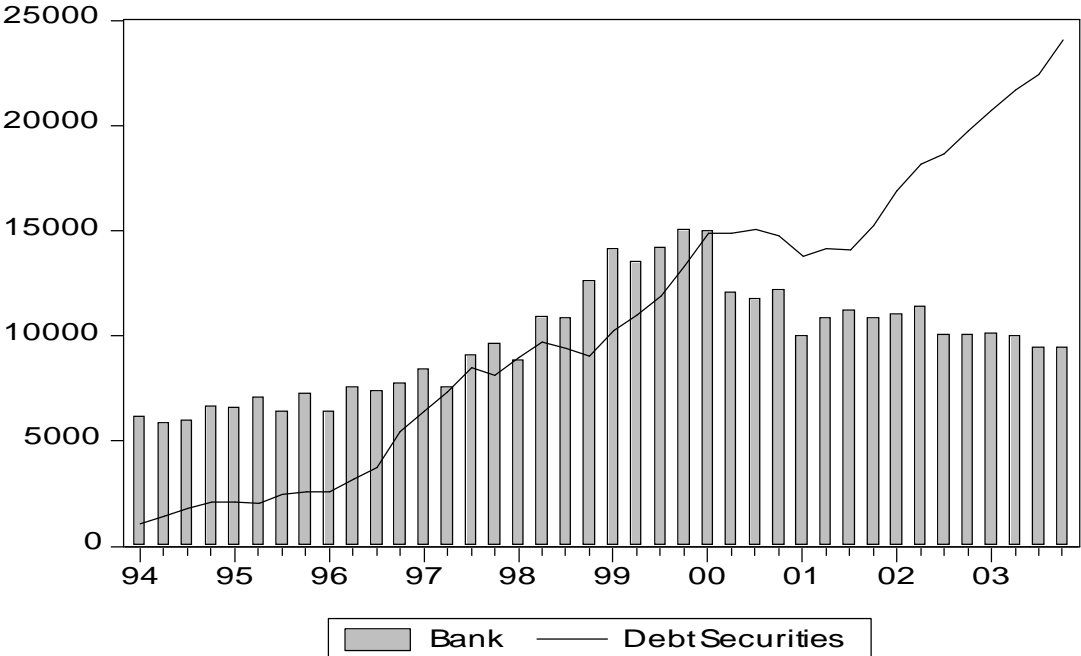


**Figure 1b: External Debts of Indonesia (as % of GDP)**

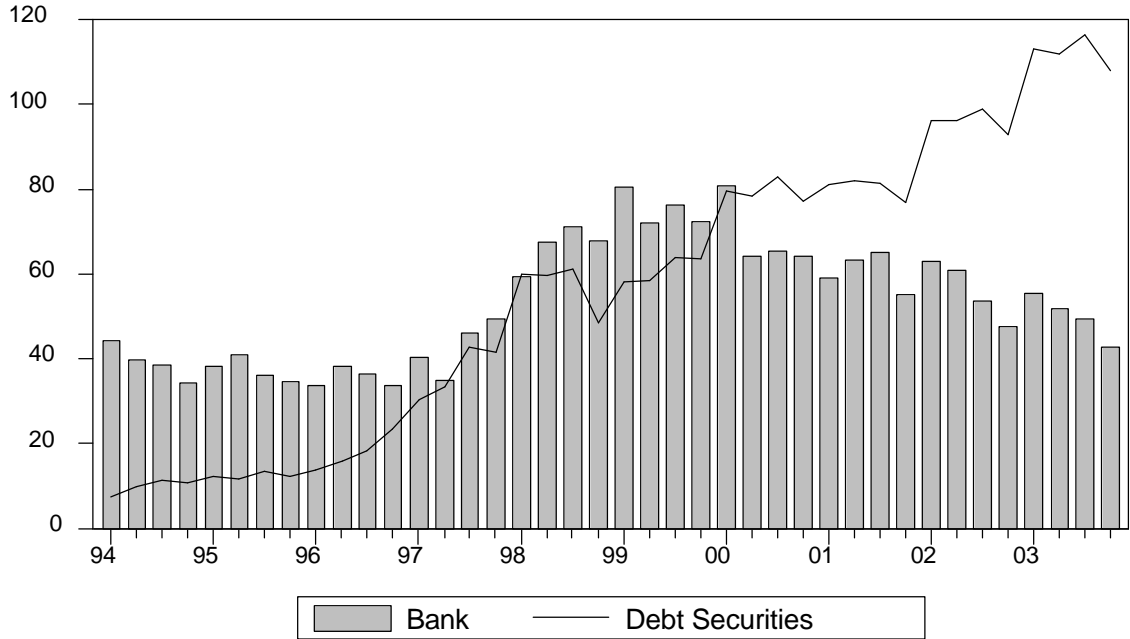


Bank: Total Claim on Bank.  
 Debt Securities: Total Debt Securities issued abroad.  
 Source: Bank for International Settlement

**Figure 2: External Debts of the Philippines (in million of US\$)**

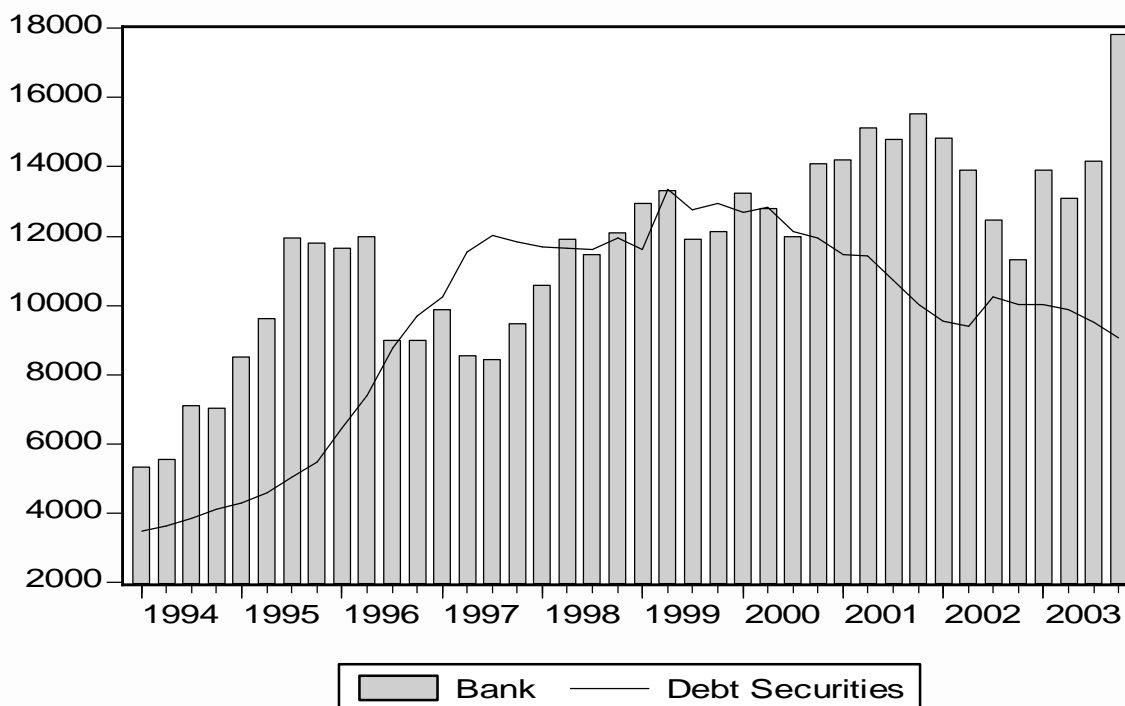


**Figure 2b: External Debts of the Philippines**

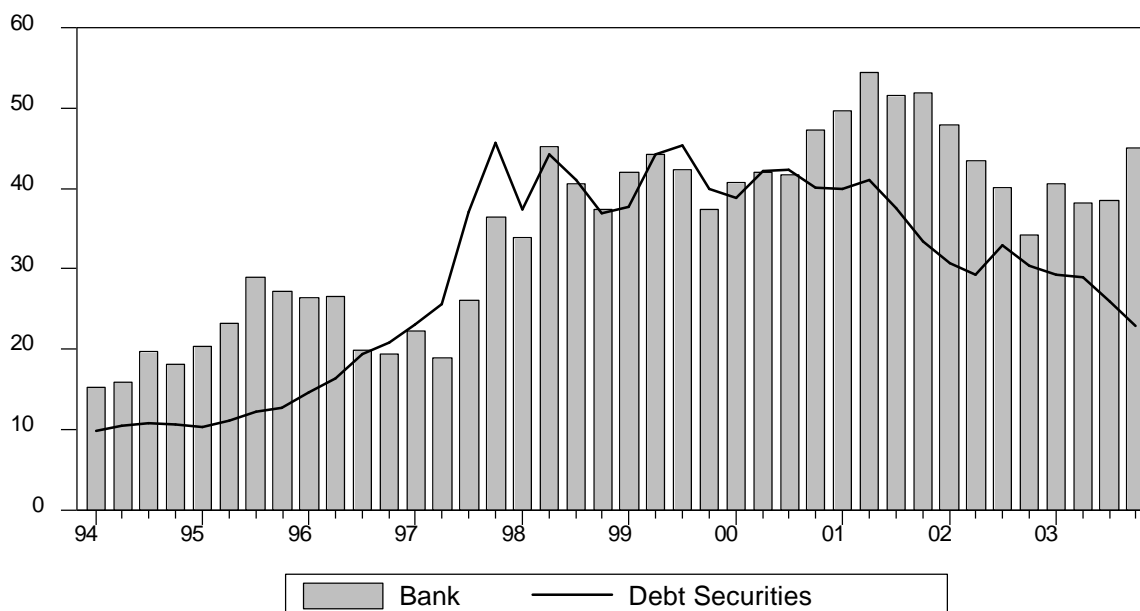


Bank: Total Claim on Bank over GDP (in %).  
 Debt Securities: Total Debt Securities issued abroad over GDP (in %).  
 Source: Bank for International Settlement

**Figure 3: External Debts of Thailand (in million of US\$)**



**Figure 3b: External Debts of Thailand (% of GDP)**

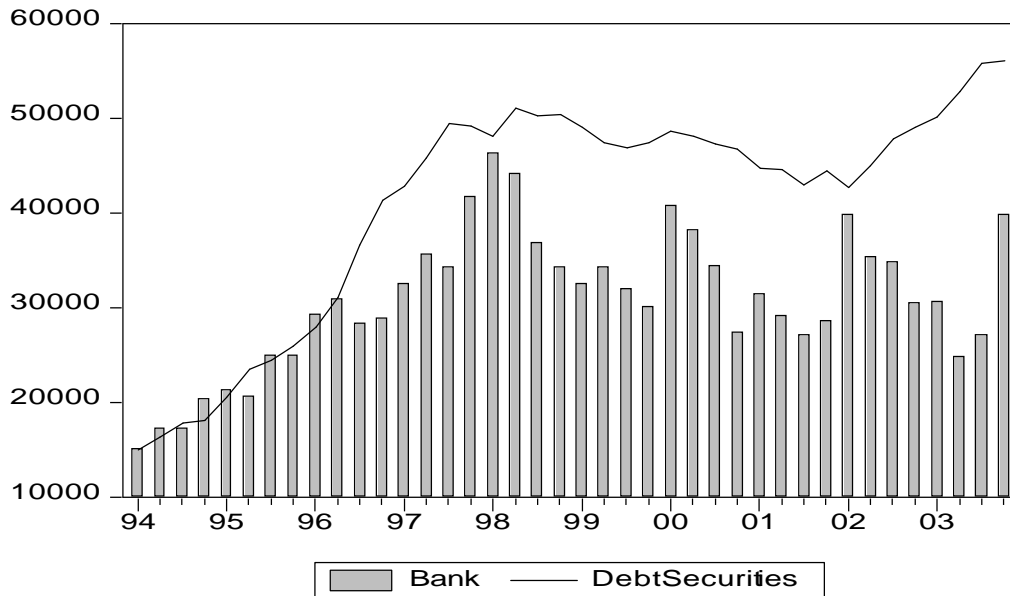


Bank: Total Claim on Bank over GDP.

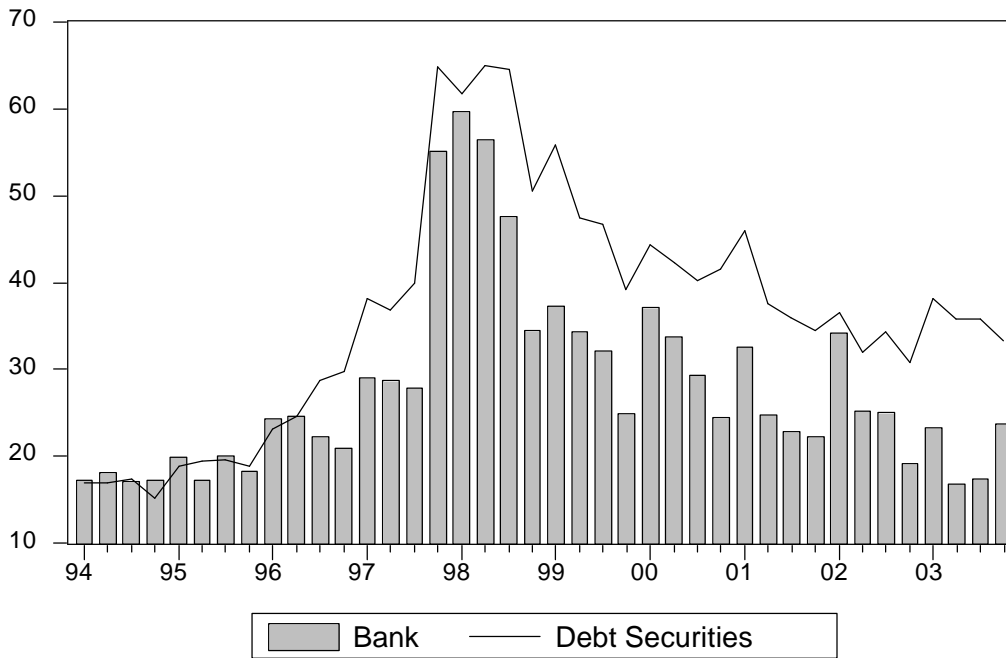
Debt Securities: Total Debt Securities issued abroad over GDP.

Source: Bank for International Settlement

**Figure 4: External Debts of Korea (in million of US\$)**



**Figure 4b: External Debts of Korea (as % of GDP)**

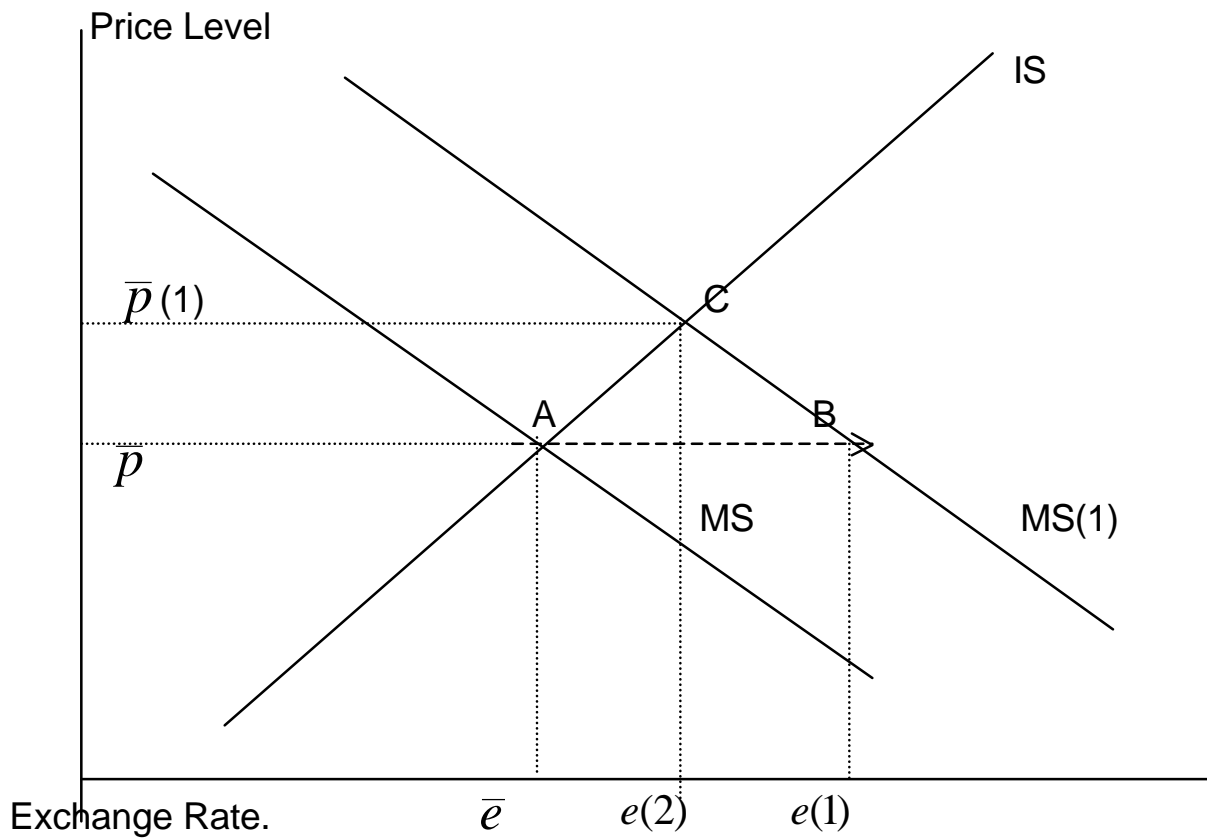


Bank: Total Claim on Bank.

Debt Securities: Total Debt Securities issued abroad.

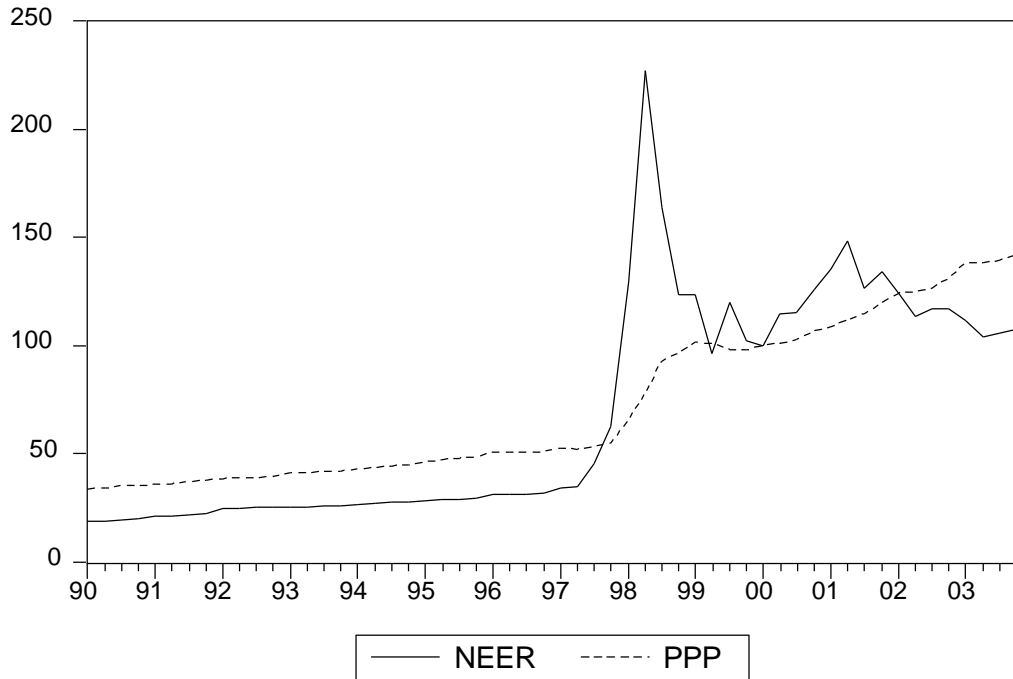
Source: Bank for International Settlement

Figure 5: External Debt and Overshooting



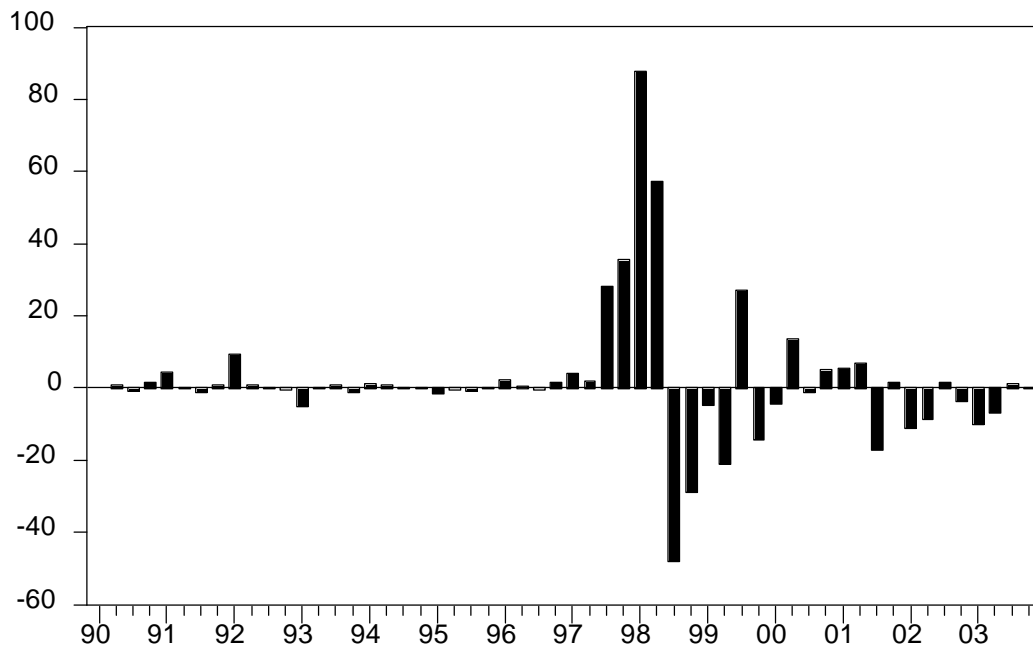
Note: A rise in ( $e$ ) implies a depreciation of the local currency.

**Figure 6: PPP Rates and NEER for Indonesia**  
(Quarter 1, 2000 = 100)



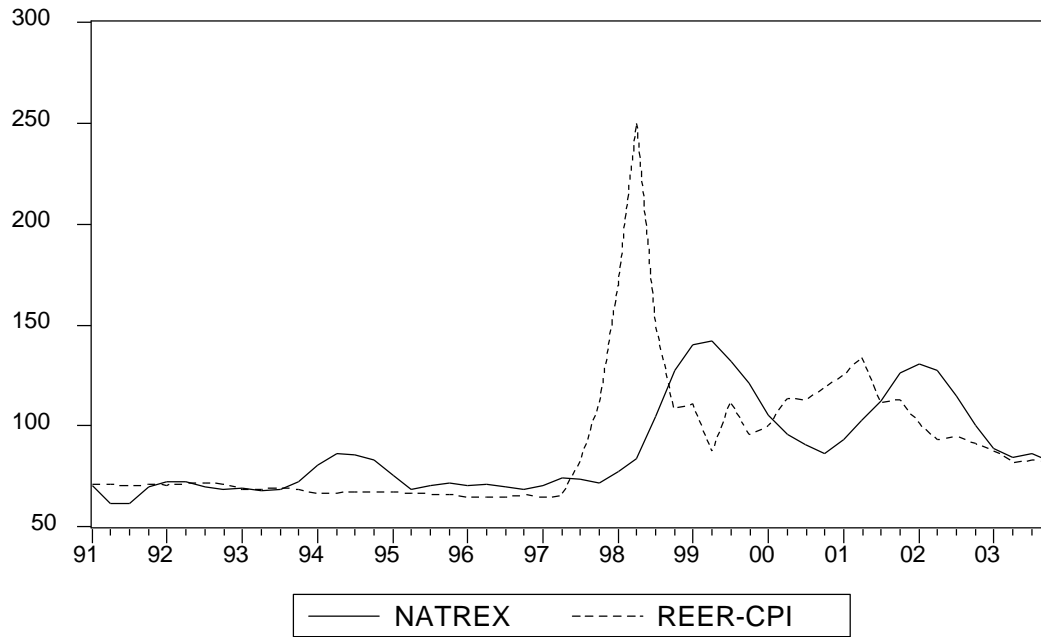
Source: Authors' own calculation

**Figure 6b: Overshooting NEER for Indonesia**  
(in percentage)



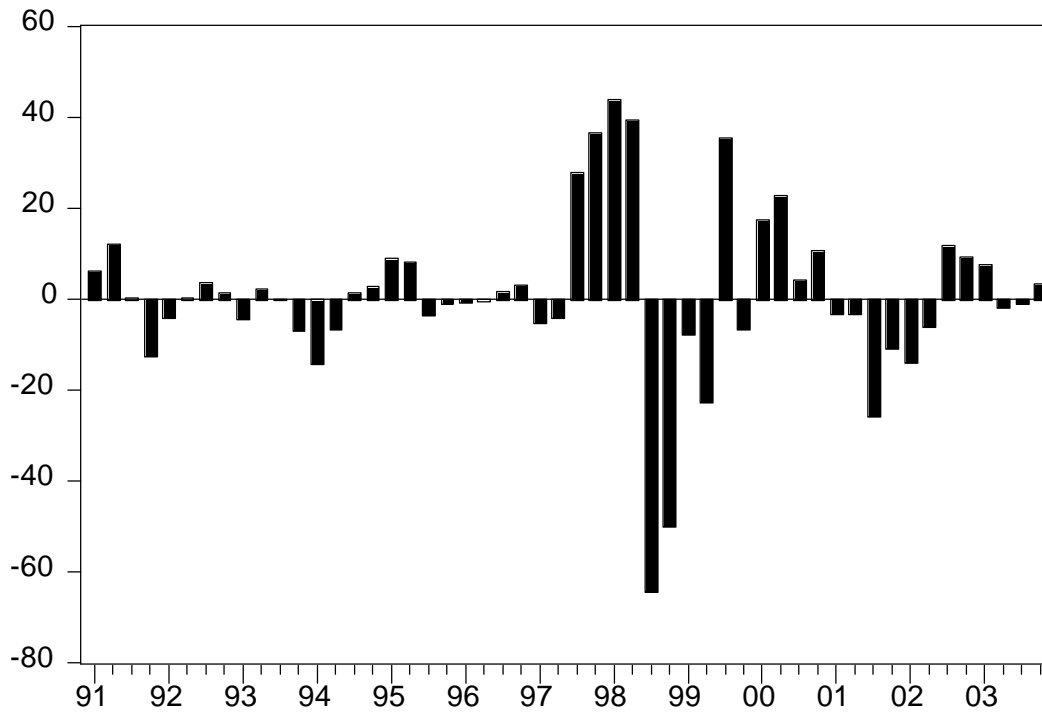
Source: Authors' own calculation

**Figure 6c: REER (CPI) and NATREX for Indonesia**  
(Quarter 1, 2000 = 100)



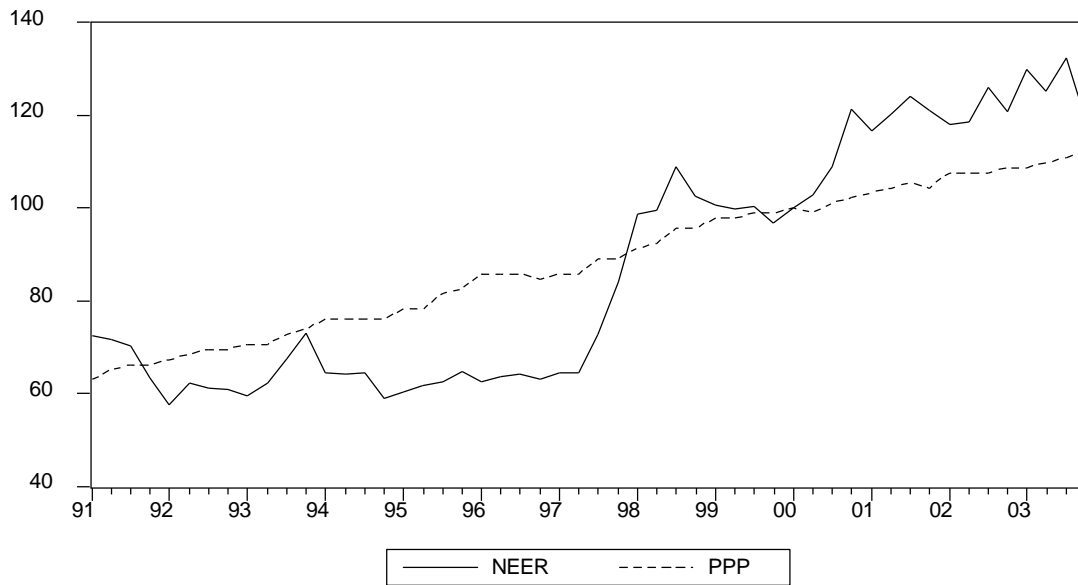
Source: Authors' own calculation

**Figure 6d: Overshooting REER for Indonesia**  
(in percentage)



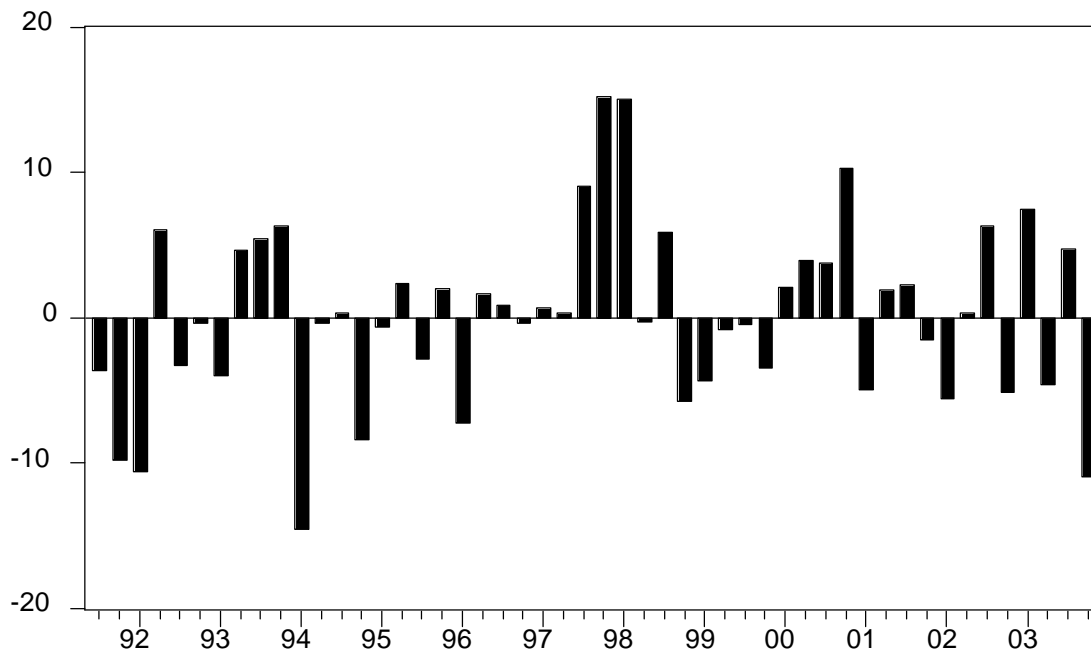
Source: Authors' own calculation

**Figure 7: NEER of the Peso**



Source: Authors' own calculation

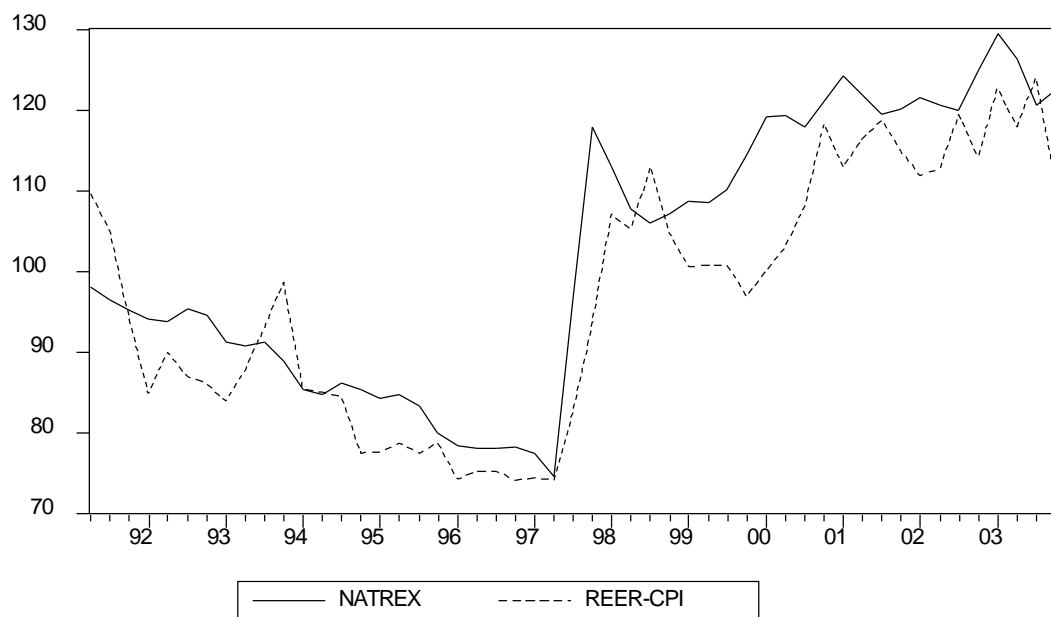
**Figure 7b: Overshooting NEER for the Philippines**  
(in percentage)



Source: Authors' own calculation

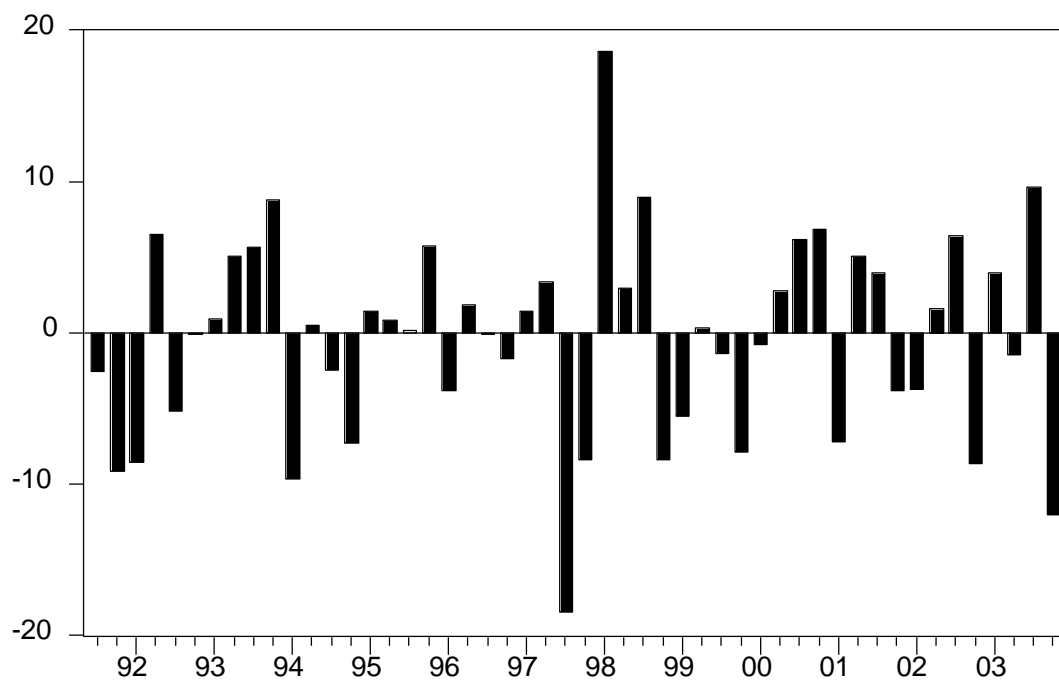


**Figure 7c: REER (CPI) and NATREX for the Peso**



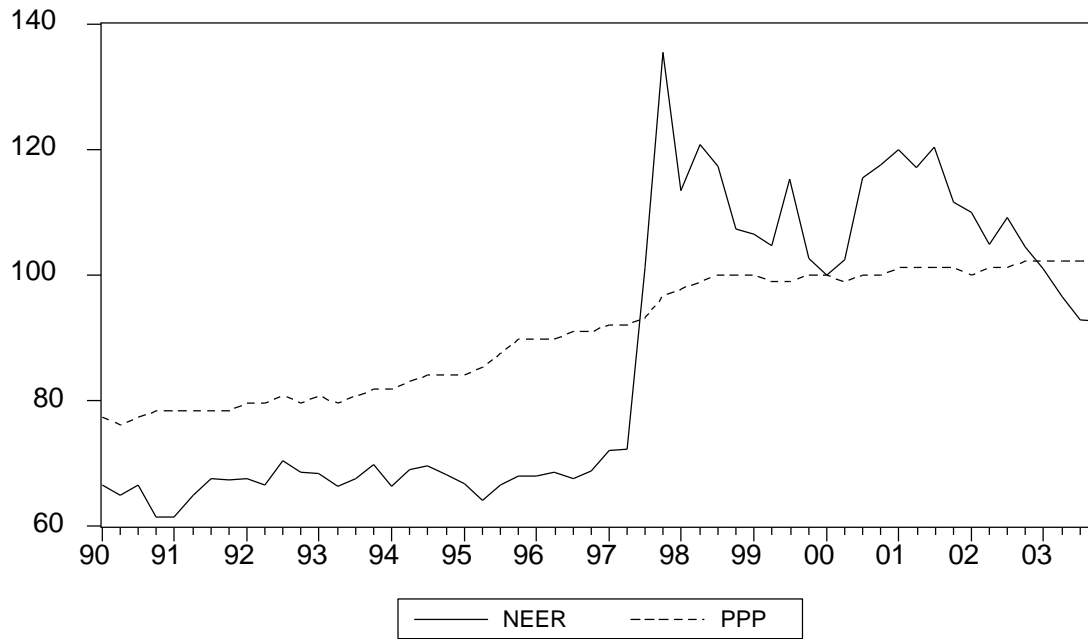
Source: Authors' own calculation

**Figure 7d: Overshooting REER (CPI) for the Philippines  
(in percentage)**



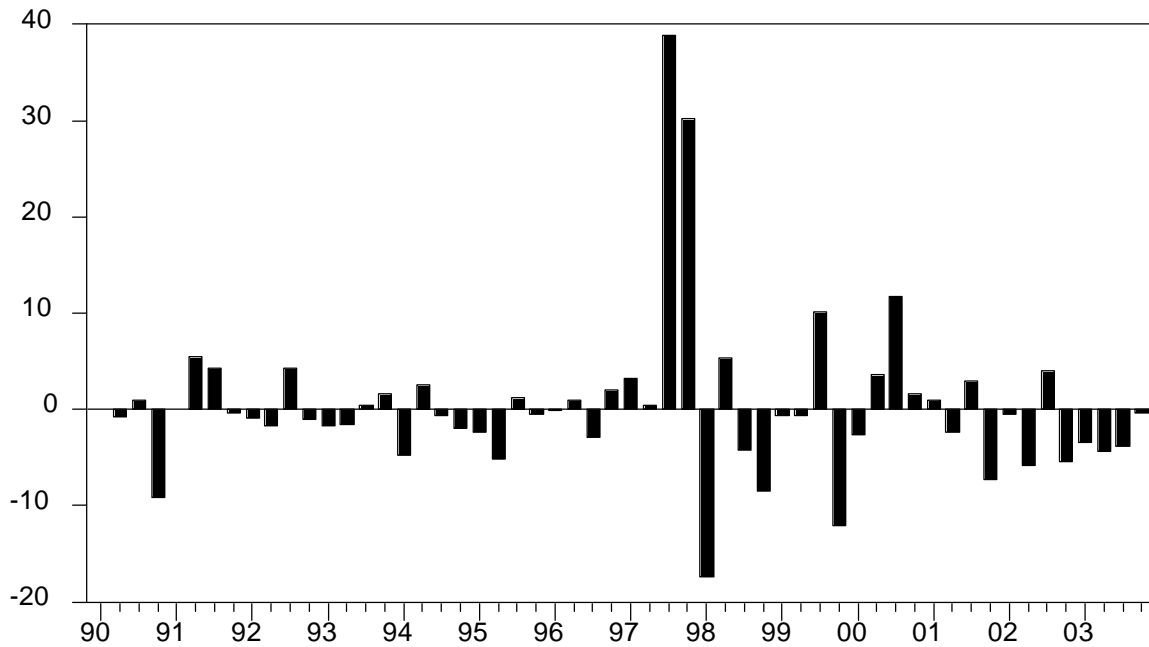
Source: Authors' own calculation

**Figure 8: NEER of Thailand Baht**  
(Quarter 1, 2000 = 100)



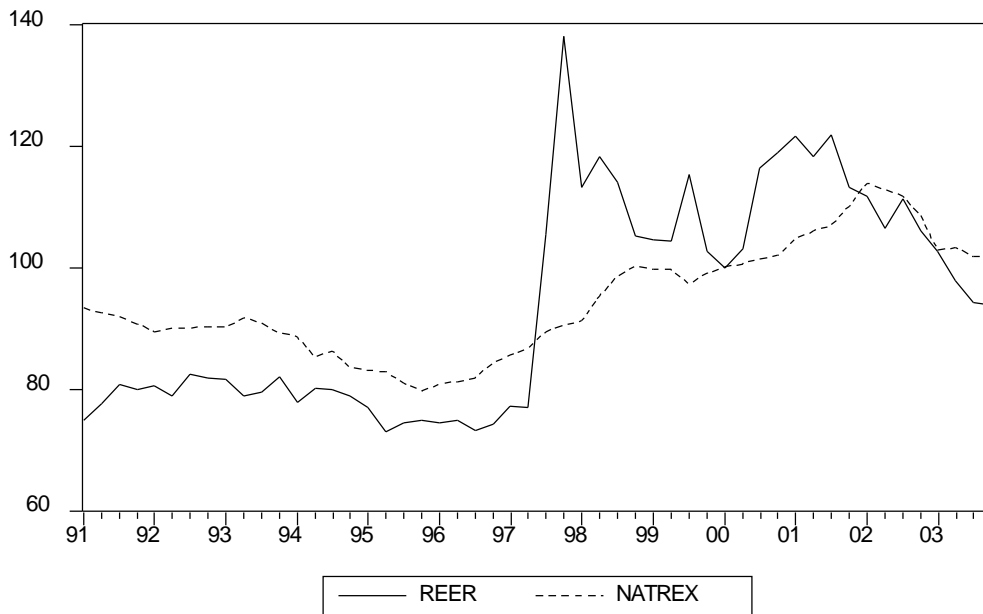
Source: Authors' own calculation

**Figure 8b: Overshooting NEER for Thailand**  
(in percentage)



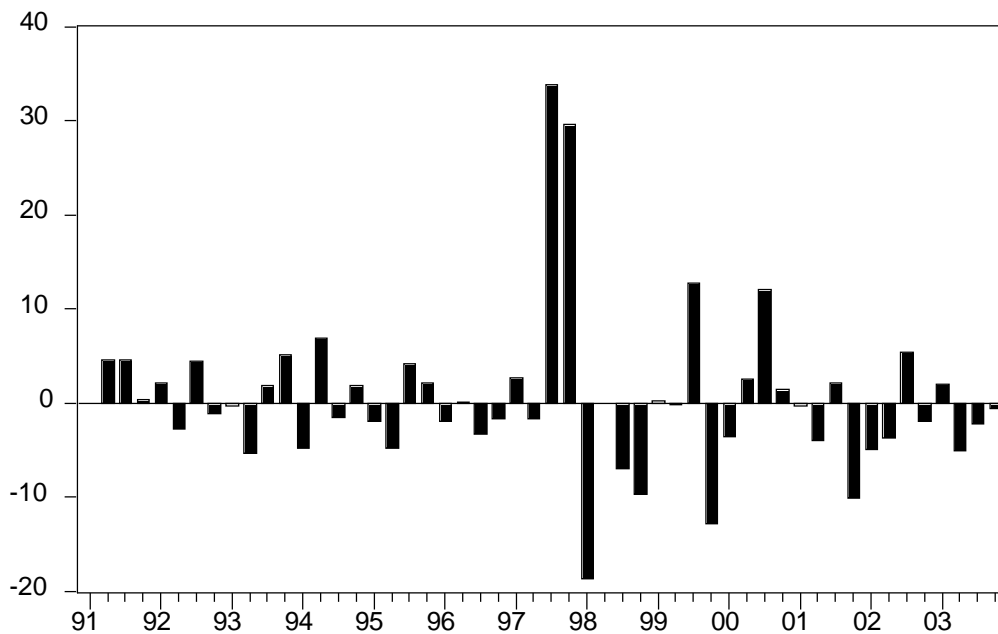
Source: Authors' own calculation

**Figure 8c: REER (CPI) and NATREX of Thailand Baht**



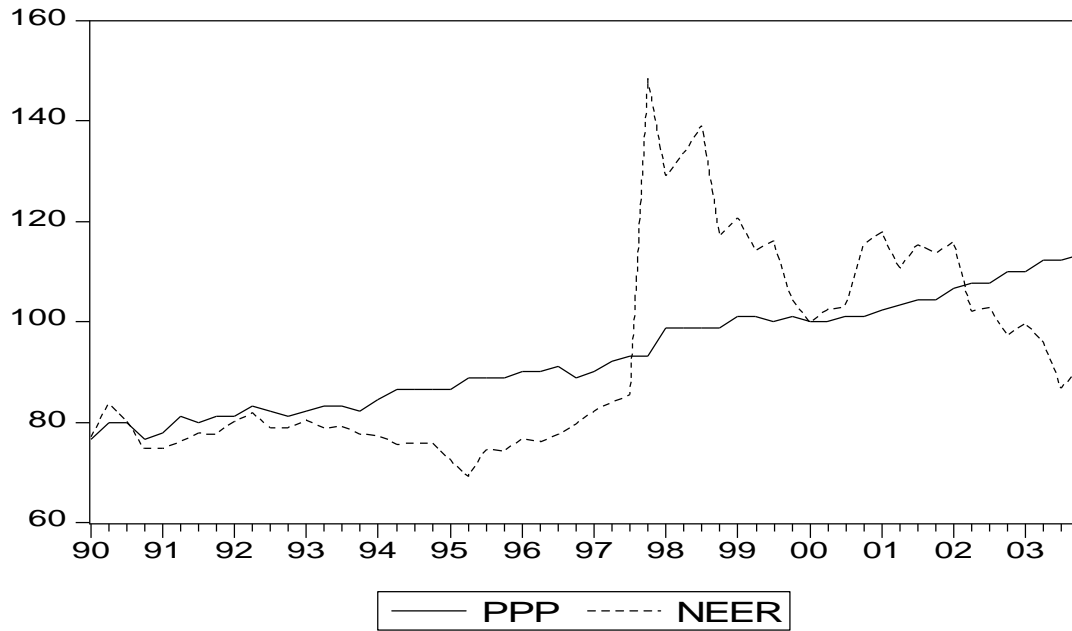
Source: Authors' own calculation

**Figure 8d: Overshooting REER for Thailand**  
(in percentage)



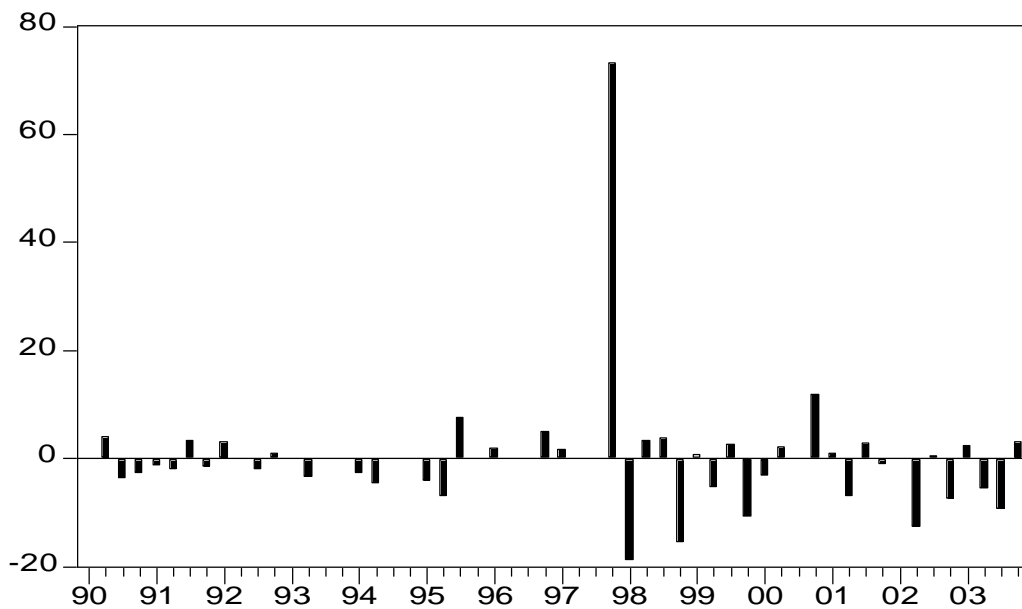
Source: Authors' own calculation

**Figure 9: NEER of Korean Won**



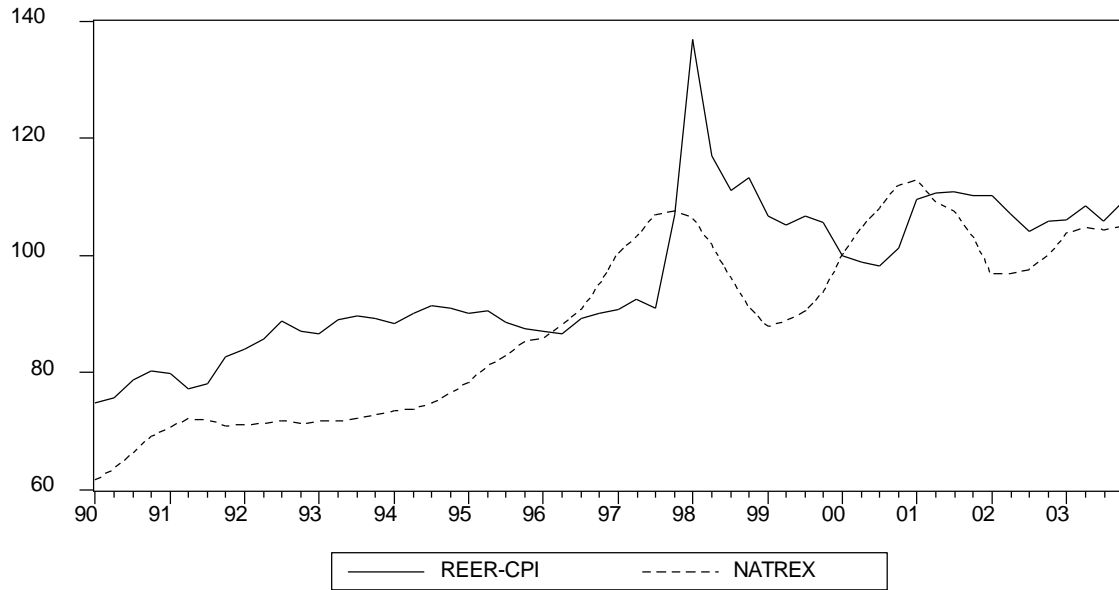
Source: Authors' own calculation

**Figure 9b: Overshooting NEER of Korean Won**  
(in percentage)



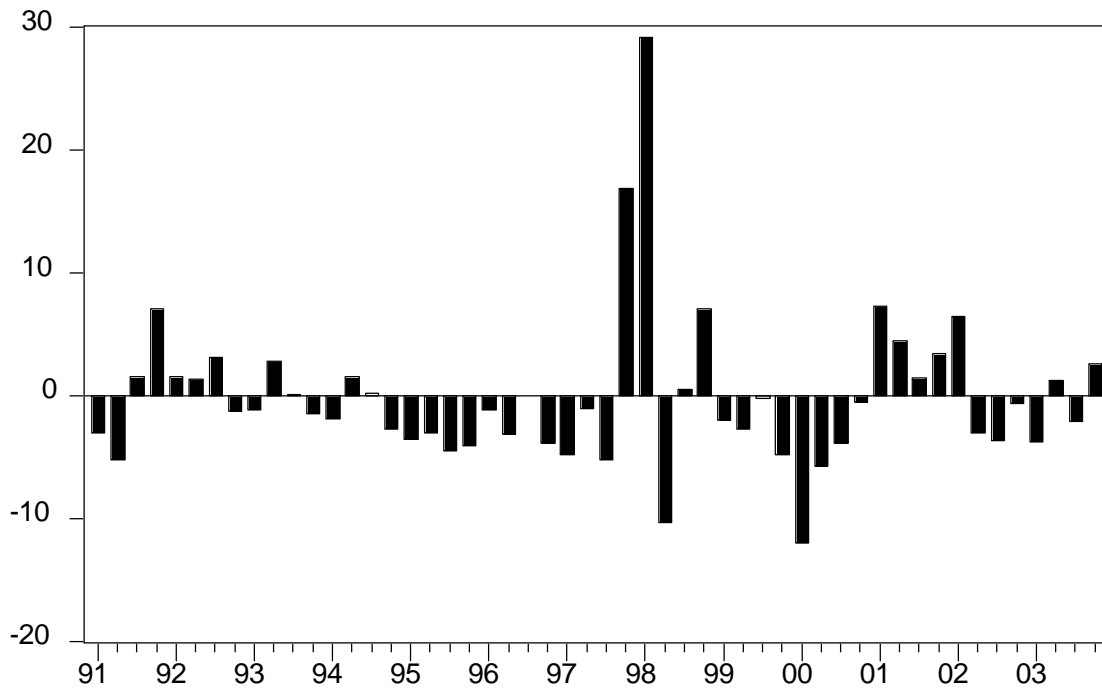
Source: Authors' own calculation

**Figure 9c: REER (CPI) and NATREX of Korean Won**



Source: Authors' own calculation

**Figure 9d: Overshooting REER of Korean Won**  
(in percentage)



Source: Authors' own calculation